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Akademie - München
from the author

ELEMENTS

OF

ELECTRO-BIOLOGY,

OR

THE VOLTAIC MECHANISM OF MAN;

OF

ELECTRO-PATHOLOGY,

ESPECIALLY OF THE NERVOUS SYSTEM;

AND OF

ELECTRO-THERAPEUTICS.

BY

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TO THE ROYAL GENERAL DISPENSARY, ETC. ETC. ETC.

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TO

WILLIAM SMEE, ESQ. F.S.A.

CHIEF ACCOUNTANT OF THE BANK OF ENGLAND,

ETC. ETC.

THIS EXPLANATION OF

THE VOLTAIC MECHANISM OF MAN

IS DEDICATED:

IN THE ASSURANCE THAT IT WILL BE ESTEEMED

AS A TRIBUTE OF FILIAL AFFECTION,

FROM HIS DUTIFUL SON,

ALFRED SMEE.

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EXPLANATION OF THE WOOD ENGRAVINGS.

FIG.

1. Astatic Galvanometer, consisting of two magnetised needles suspended by a piece of silk-worm's silk. For its employment, great care must be taken that the sun should not shine upon the needles, which causes them to oscillate, or that any vibration should act upon them. Very delicate experiments are best performed during the stillness of night.
2. Acarus of Cross.
3. Acarus of Weekes.
4. Cylindrical Electrifying Machine.
5. Plate ditto.
6. Insulating Stool.
7. Head, shewing divergence of hairs under tension.
8. Leyden Jar.
9. Ditto, with Lane's discharging Electrometer.
10. Leyden Battery.
11. Henley's Quadrant Electrometer, for measuring amount of electricity of tension.
12. Armstrong's Hydro-Electric Machine.
13. Thermo-Electric Battery.
14. Cruikshank's Battery.
15. Primary Coil, with soft iron centre.
16. Backhoffner's Electro-Magnetic Machine. By a modification of this, I obtain a single current instead of a to-and-fro current.
17. Horne and Thornthwaite's Electro-Galvanic Machine: z, zinc of the battery; s, silver; A, screw to regulate the vibration of the machine; B, watchspring vibration; C, water regulator; 1D, 2D, directors for applying the electricity.
18. Ditto ditto, with different lengths of secondary wire, to adjust the power of the instrument.
19. Ditto ditto, arranged for the convenience of packing.
20. A still larger machine of similar class, with contrivances for removing the inclosed soft iron, which gives to the operator a still further power of regulating the amount of electricity.
21. A Magneto-Electric Machine.
22. Platinised Silver Battery in porcelain trough.
23. Sulphate of Copper Battery: z, zinc; A. acid; s, solution of sulphate of copper; P, porous pot.
24. Nitric-Acid Battery: A, acid; z, zinc; P, porous pot; N, nitric acid.
25. Woollaston Battery.
26. Handles for the patient to hold during the application of electricity.
27. Radford's Conductor, for use in uterine inertion, amenorrhœa, etc.
28. Instrument for applying electricity to the eye.
29. Ditto ditto ditto tooth. And the other portion to screw on for applying to the ear.
30. Flat Pole, occasionally used for the application of electricity.
31. Sponge, contrivance well adapted for applying electricity to the skin.
32. Pole, occasionally employed.
33. Ditto, for including portions of the body.
34. Electric Magnet: s s, binding screws; w, wire; B, plate of brass, covering the soft iron.
35. Platinised Silver Pot Battery: s, silver; z, zinc; B, binding screw; A, acid; w, wood.
36. Magnetic needle.

PREFACE.

This little volume, however incomplete, and however unsatisfactory it may be found to the reader, has nevertheless cost me much time, labour, and thought. I have been for ten years engaged at intervals upon it; and its very slow advance, from year to year, has been a constant annoyance to myself.

The experiments, upon which this work is mainly founded, are of two kinds, physical and physiological. The physical experiments relate principally to the laws of voltaic electricity, and were, to a great extent, also required for my treatise on Electro-Metallurgy. To that work I must refer my readers for details, which it has not been considered necessary to repeat here.

I feel that an apology is due to the public, for having allowed the Elements of Electro-Metallurgy to be out of print so long; but press of business has prevented me from again directing my attention to the subject. Certain special investigations have been required in voltaic electricity, which have led to the consideration of hydro-voltaic, electro-, photo-, and thermo-voltaic circuits. Throughout this volume, I

have also referred to my "Sources of Physics," which was written expressly as an introduction to the present work three or four years ago.

The physiological matter required two lines of investigation; the one having reference to the ultimate structure of organic beings; the other, to the actions taking place in them. The anatomy of the part demanded very perfect modes of injection, and led to the employment of the carmine mixture, which, I have no hesitation in stating, is the most perfect and beautiful material for filling the capillaries of muscle and brain which has ever been discovered.

In examining the actions of the body by the electro-voltaic test, the mechanism of nervous actions has been determined. Besides these subjects, extensive experiments have been performed upon plants and various vegetable tissues.

These researches have occupied my time largely, and I will beg those who consider them imperfect or incomplete, to bear in mind that they have been performed in my own private dwelling, unaided by the advantages which public laboratories afford to their fortunate occupiers.

I am fully aware that the results of immediate research are esteemed in this country almost to the exclusion of deductions which may be made therefrom. Nevertheless, the higher parts of physiology must, in great measure, for ever depend upon deductions, and cannot be the result of immediate experiment. In this work, my attempt to deduce the physical structure of the brain has been found so difficult, that it could only

be prosecuted when I have been entirely removed from my ordinary business, and even then, the advance, year by year, has been exceedingly slight.

The study of the mechanism by which forces are generated in the body, has given rise to the artificial gymnotus, and to the formation of artificial muscular substance, the study of which appears to me to be interesting.

Having developed the voltaic mechanism of animal life, I considered that it would be advisable to study the electro-pathology of diseases, and the influence of electricity in their cure. Whilst, however, electricity appears to me to be an important agent for the cure of disease, the cases in which it is especially valuable are comparatively few; and I myself regard the treatment upon general electro-therapeutic laws as more valuable than the immediate action of electricity itself.

In submitting this volume to the Public, I regard it as a beginning of a subject, not as an end; as a commencement of the study of Physiology upon the laws of physics, which will require the united efforts of physiologists to render it more complete. It is a worthy subject for the talent of the country to be engaged upon, and nothing but the associated labours of many can render it of ultimate value.

My original intention was to have compared the labours of other investigators of the nervous system, and to have shewn the points in which former writings agree, and those in which they disagree; and also to have examined the various researches already

made by Philosophers on animal electricity. I found, however, that I had neither space nor time for this laborious undertaking, and I have therefore confined this work to the result of my own investigations and deductions.

During the progress of this volume, I have derived much assistance from my publishers, Messrs. Horne, Thornthwaite, and Wood, and other gentlemen, who have aided me in various ways. I have, however, especially to return my grateful acknowledgments to my kind and much-esteemed friend, Mr. John Beadnell to whom I am indebted for a revision of the proof-sheets.

7, Finsbury Circus,

24th February, 1849.

☞ *The printing of this Book was completed February 24th*, 1849.

ELECTRO-BIOLOGICAL MAP (No. 1).

AISTHENICS.

Right Side. — **Left Side.**

ELECTROLYTE.

Eye
Ear
Nose
Tongue
Skin
Mechanism of Bodily Sensation.

POSITIVE.

BIO-TELEGRAPHS, PERIPHERAL SENSOR NERVES. BATTERY.

PERIPHERAL BIO-TELEGRAPHS, BATTERY. SENSOR NERVES.

PHRENO-AISTHENICS.

Units of Sensation.		**Units of Sensation.**
NEGATIVE.		NEGATIVE.
ELECTROLYTE.		ELECTROLYTE.
POSITIVE.		POSITIVE.
Units of Sensation.	**Commissure.**	**Units of Sensation.**

SYNDRAMICS.

Combination of Units of Sensation.		**Combination of Units of Sensation.**
NEGATIVE.		NEGATIVE.
ELECTROLYTE.		ELECTROLYTE.
POSITIVE.		POSITIVE.
Combination of Units of Sensation.	**Commissure.**	**Combination of Units of Sensation.**

BIO-TELEGRAPHS, SENSOR NERVES.

CENTRAL BATTERY, OR BRAIN.

CENTRAL BATTERY, OR BRAIN.

AISTHENIC-NOEMICS.

Totality of Combinations of each Sense.		**Totality of Combinations of each Sense.**
NEGATIVE.		NEGATIVE
ELECTROLYTE.		ELECTROLYTE.
POSITIVE.		POSITIVE.
Totality of Combination of each Sense.	**Commissure.**	**Totality of Combination of each Sense.**

SYNDRAMIC-NOEMICS.

Combination of Totality of each Sense.		**Combination of Totality of each Sense.**
NEGATIVE.		NEGATIVE.
ELECTROLYTE.		ELECTROLYTE.
POSITIVE.		POSITIVE.
Combination of Totality of each Sense.	**Commissure.**	**Combination of Totality of each Sense.**

PNEUMA-NOEMICS.

Totality of Combinations of Totalities of each Sense and both Sides.

NEGATIVE.
ELECTROLYTE.
POSITIVE.

BIO-TELEGRAPHS, MOTOR NERVES.

BIO-TELEGRAPHS, MOTOR NERVES.

DYNAMICS.

PERIPHERAL BATTERY.

PERIPHERAL BATTERY.

NEGATIVE.	NEGATIVE.
Muscle.	**Muscle.**
ELECTROLYTE.	ELECTROLYTE.
Right Side.	**Left Side.**

ELECTRO-BIOLOGICAL MAP (No. 2).

Right Side. | **Left Side.**

EAR.	EYE.	NOSE.	MOUTH.	SKIN.
a b c	d e f	g h i	j k l	m n o

AISTHENIC BATTERY.

a b c	d e f	g h i	j k l	m n o
				Commissure.
l	*l*	*l*	*l*	*l*
a b c	d e f	g h i	j k l	m n o

a b c	d e f	g h i	j k l	m n o
				Commissure.
r	*r*	*r*	*r*	*r*
a b c	d e f	g h i	j k l	m n o

SYNDRAMIC BATTERY.

l a b *l* a c *l* c b *l* a b c	*l* d e *l* d f *l* e f *l* d e f	*l* g h *l* g i *l* h i *l* g h i	*l* j k *l* j l *l* k l *l* j k l	*l* m n *l* m o *l* n o *l* m n o
				Commissure.
l	*l*	*l*	*l*	*l*
A B C D	E F G H	I J K L	M N O P	Q R S T

r a b *r* a c *r* c b *r* a b c	*r* d e *r* d f *r* e f *r* d e f	*r* g h *r* g i *r* h i *r* g h i	*r* j k *r* j l *r* k l *r* j k l	*r* m n *r* m o *r* n o *r* m n o
				Commissure.
r	*r*	*r*	*r*	*r*
A B C D	E F G H	I J K L	M N O P	Q R S T

AISTHENIC NOEMIC BATTERY.

H	**V**	**S**	**T**	**F**
				Commissure.
L H	L V	L S	L T	L F

H	**V**	**S**	**T**	**F**
				Commissure.
R H	R V	R S	R T	R F

SYNDRAMIC NOEMIC BATTERY.

V H L	S H L	T H L	F H L	
V S L	T H L	F H L		
V T L	F H L			
V F L				
V S T L	V S T L	V T F L	S T F L	
V S F L	V T F L	S T F L		
V T F L	S T F L			
V S T F L				
a b c d e f g h i j k l m n o p q r s t				

V H L	S H L	T H L	F H L	
V S L	T H L	F H L		
V T L	F H L			
V F L				
V S T L	V S T L	V T F L	S T F L	
V S F L	V T F L	S T F L		
V T F L	S T F L			
V S T F L				
a b c d e f g h i j k l m n o p q r s t				

PNEUMA-NOEMIC BATTERY.

Totality.

DYNAMIC POLE.

1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9

Muscular Substance.

Right Side.

1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9

Muscular Substance.

Left Side.

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ELECTRO-BIOLOGY;

OR,

THE VOLTAIC MECHANISM OF MAN.

CHAPTER FIRST.

ELECTRO-BIOLOGY.

1. Definition of Life.—2. Specific Actions of Life.—3. Organic Life.—4. Nerve.—5. Ganglia and Brain, General Functions of.—6. Nature of Life.—7, 8. Vital Phenomena purely Physical.—9. Immortality.—10. Requisites for Life.—11. Analogy between the Vital Apparatus and Voltaic Battery.—12. Extent of this Analogy.—13. Liebig's Arrangement.—14. Animal Battery.—15. Conditions necessary for.—16. Hydro-Voltaic Circuits; Induced Circuits.—17. Electro-Voltaic Circuit.—18. Current developed by Muscular Action; Experiment.—19. Deduction from.—20. Conditions for Experiment.—21. Peripheral Battery.—22. Structure of, in the Animal.—23. Central Battery.—24. Electro-Biological Circuit; Conditions necessary for.—25. Causes of Death; Electro-Biologically considered.—26. Sub-division of Biology.

(1). LIFE is a condition difficult to define, because it does not denote one constant state in the body to which it appertains, but refers to a series of changes continually occurring. The illustrious Bichât considers it to be "the sum of the functions by which death is resisted"; but this, to my mind, is not an intelligible definition. If we regard the state of a living animal, we find that it consists of two parts, a solid and a

fluid. Between these two parts changes are continually occurring. Life, therefore, comes under our notice only as an idea which we form of a solid and fluid body in a state of action, and thus may be defined to be—"The idea of the performance of certain specific actions between the parenchyma and blood or fluid of an organised being."

(2). The certain specific actions of life are those of growth, nutrition, and excretion, in certain cases, the generation of a particular temperature; in others, as in the glow-worm, of light; in others, as in the electric eel, of electricity. We observe sound to be produced in many organised beings; as, for instance, in the singing of birds; and, lastly, the power of generating force extends to a greater or less degree over the entire animal creation.

(3). Assimilation, growth, nutrition, excretion, and perhaps, the generation of a certain temperature, are common to all organised bodies, and may be termed the vegetable life; or, speaking more generally, the organic life—phenomena which in this work it is not my purpose to consider in detail.

(4). Besides the phenomena, classed together as the phenomena of organic life, there are yet others, which we find in the higher animals in great perfection, and which, by analogy, we may infer to belong to the lowest creature in the scale of creation. The phenomena to which I allude require for their manifestation, a more complex apparatus than that of the simple fluid and tissue to be found in all plants. We find that animals, to exhibit these phenomena, require a central parenchyma supplied with blood, a peripheral parenchyma supplied with blood, and a connection between the two, consisting of a peculiar tissue, called "Nerve-Fibre."

(5). The central parenchyma constitutes the ganglia of lower animals, the brain of higher. The peripheral parenchyma comprises the organs of sensation and motion. A proper supply of bright arterial blood to both situations is requisite for the manifestation of the phenomena of life. By this apparatus the

animal receives impressions from the external world, transmits them to the brain, registers them, combines them, and acts, not only on immediate impressions, but also upon those which it has received at former periods. These functions are termed the functions of animal life; and these alone will occupy our attention in the present volume.

(6). From the facts which I have already stated, we perceive that the vital functions are divided into two classes, those of animal life, and those of organic life; and to the idea of both collectively we assign the general term of vitality. Life, then, is one word used to signify a number of changes. It is no independent reality apart from the matter which exhibits these phenomena. Neither is it an imponderable attached to matter. Nor is it an all-pervading ether, or *anima mundi*, filling space, as some philosophers would have us suppose; but in its widest signification it is one word used to designate the combined functions of assimilation, growth, nutrition, excretion, the reception of impressions, the registration of impressions, the combination of impressions, together with the production of force, electricity, light, heat, sound, etc. Such is life, an idea necessarily inferring action, and realising the poet's thought,

> "She dreads an instant pause, and lives but while she moves."

(7). In organised beings, therefore, the changes occurring in the organisation alone constitute the vital phenomena. Hence all animal beings, and even man himself, is solely constituted of matter, and obedient to physical laws. All phenomena of nutrition, growth, assimilation, excretion, together with the action of the senses, of memory, of thought, of reason, of action by word or deed, are phenomena produced by virtue of organisation, and consequently solely obedient to physical laws.

(8). Whilst the dissecting-room reveals to us the structures

necessary for the organisation, the laboratory the composition of the respective parts undergoing change, universal science demonstrates that even proud man himself is not endowed with any imponderable, ether, or any other than a physical property for the purpose of manifesting any of those phenomena which are classed under the head of vital actions.

(9). Man, however, is immortal. Man at all times, and in all regions, has believed in his immortality. It is probable that this conviction has its origin in his very organisation. Now that which gives to man his immortality can have no relation with that which is mortal. Life, mind, thought, reason, knowledge, come from organisation and cease at death. "When the breath of man goeth forth, he shall turn again to his earth; and then all his thoughts perish."

(10). A central parenchyma, a peripheral parenchmya, connected together, and each supplied with bright arterial blood, are necessary to life. It follows, therefore, that bleeding causes death—that the supply of imperfect blood, such as carbonaceous blood, is insufficient to life. Moreover, a destruction of the central parenchyma, by injuring the brain, or of the peripheral, by destroying the body, instantly prevents the manifestations of the functions of animal life. Lastly, a separation between the central and peripheral parts, as in the act of pithing, is attended with the same result.

When action ensues, a change of matter occurs, which is proved by an increased excretion, and corresponding desire for food. This fact demonstrates that the functions of animal life are obedient to the general physical law, that no force can be generated without some corresponding equivalent change of matter.

(11). Putting all these facts together, we must seek for some physical apparatus which shall agree with the requisites for the maintenance of organic life. Now a central apparatus,

supplied with a peculiar fluid, a peripheral apparatus similarly supplied, the whole connected together to form one universal total, is the apparatus desired, and such an apparatus we have in a double voltaic battery.

$$\left\{ \begin{array}{c} Z \text{——} S \\ S \text{——} Z \end{array} \right\}$$

Now, if we abstract the proper exciting fluid from either end, or substitute any other fluid, or destroy the structure either at one end or the other, or divide the connecting portions or wires, the effects proper to the apparatus will not be manifested, and the battery will be destroyed.

(12). But the ordinary forms of voltaic battery would not answer to the physical mechanism of man. A human being contains no metallic plates, no metallic wires, but consists solely of animal membranes and fluids; and, therefore, we have to study voltaic batteries, solely composed of membranes and fluids, with connecting apparatus, the parts of which may be imitated by the materials naturally existing in the body.

(13). Liebig has already stated, that "Professor Buff has, at his request, constructed a pile, consisting of discs of pasteboard moistened with blood, of muscular substance (flesh), and of brain. This arrangement caused a very powerful deflection of the needle of the galvanometer, indicating a current in the direction of the blood to the muscle."

(14). Before the time of Liebig, Galvani had shewn that convulsions ensued in a limb, by simply bringing into connection the muscles and nerves. In the muscles we have a nitrogenised material which is acid; in the blood we have a nitrogenised material which is alkaline; and the connecting part or nervous fibres are neutral. We may imitate such a combination, by using a solution of ferrocyanate of potash, a compound of iron, nitrogen, carbon, and potash, with a little alkali for one side, a solution of the red ferrocyanate for the other side,

and connect the two with a solution of chloride of sodium, or common salt.

(15). If we regard the conditions necessary for a voltaic battery, we find that some body, either solid, fluid, or gaseous, in a state of adhesion, which has an affinity for oxygen, is required for the positive pole. Such a compound is the ferrocyanate of potash, and such a compound is the liquor sanguinis. For the negative pole, some highly oxygenated substance, or substance which easily parts with hydrogen, is required. This exists in the red ferrocyanate. This exists also in the red corpuscules of the blood, or perhaps in muscular fibre. These two parts must be connected together. In the natural circuits they are connected by the nerve; in the artificial by the chloride of sodium. I have at various times contrived many varieties of this form of circuits, which I propose to term Hydro-Voltaic Circuits.

(16). In the Hydro-Voltaic Circuits, we have a circuit similar to that generated in animals. No means, however, have heretofore been devised to indicate its presence in a single circuit. For many years I have felt this difficulty, and for a long time it seemed to me insurmountable, until the time of the prosecution of my electro-metallurgic experiments, when I observed the curious facts which I have detailed under the term of induced voltaic circuits. An induced voltaic, or electro-voltaic circuit, is a circuit which would not exhibit voltaic effects unless it were acted upon by electrical force; for instance, two iron wires in the same solution would cause no current: but if the two wires are situated in the path of another voltaic circuit, a secondary induced circuit is produced. In my Treatise on Electro-Metallurgy, I have shewn that even platina wires, with powerful currents of electricity, may exhibit the phenomenon, though the effect is far more readily apparent, when metals are employed which are competent to set in action electricity, but are simply in a condition unsuited for polarity.

(17). If we take two perfectly polished steel needles, and let them remain in any liquid for a short time, so that they may be under the same circumstances, they will exhibit no indications of electricity. When, however, a voltaic current acts upon the liquid, they immediately evince the properties of a voltaic circuit. The one near the negative pole of the battery will become positive; the other, near the positive pole, will become negative; and it is to this circuit that I shall have frequent occasion to make reference during this treatise, and which I propose to designate by the term of Electro-Voltaic.

(18). By employing the electro-voltaic circuit, we have a test by which we can ascertain the presence of a current in any hydro-voltaic combination, or supposed combination, even if it be limited to a single cell. Having thus obtained the mechanism for examining animal bodies, the time arrived for applying the test to the living creature. The first animal which was honoured was a black rabbit, into the masseter of which I introduced one sewing needle, whilst the second was placed in the subcutaneous cellular tissue. After leaving them for a few minutes, so that they might be in the same state, they were connected with the galvanometer, without sensible deflection of the needle. After a few moments, the animal not liking its treatment, made an attempt to bite my finger, and the deflection of the galvanometer instantly showed the mechanism of volition. I then gave the creature a piece of wood to bite, upon which it used all its power of mastication, and by catching the oscillation of the needle, a very powerful current was exhibited.

(19). In this experiment, the deflection of the needle in the electro-voltaic circuit proved the existence of a voltaic current passing through the parts during the action of biting; and did thus denote the mechanism of the force employed to throw the muscles into operation.

(20). My object in this work is rather to detail such results

as will induce others more fully to investigate the phenomena, than to attempt to enter minutely into each separate experiment. I may notice, that for the manifestation of the electro-voltaic current, the animal should be in good robust health, and muscular; however, during the experiment, the animal should be at its ease, and should rather exercise its powers voluntarily, than from irritants applied to the surface, though hereafter I shall have to point out that by pinching, or otherwise irritating, the same result may ensue. A feeble animal, or an animal under great fear exhibits the force but feebly. A powerful animal gives strong indications of the voltaic current when one needle is placed in the muscles of the back, the other under the skin.

(21). Inasmuch as the two needles are placed respectively in the skin and muscle of the animal, it follows that the current is greatest between those two parts, as the needle must be enclosed in the path of the current to exhibit the phenomena. The periphery or body, therefore, consists of the muscular substance, forming one pole, the cutaneous tissues the opposite, the serous fluid, which lubricates the parts, being the electrolyte. The whole forms a voltaic battery, which I shall hereafter consider in minute detail, as the Peripheral Battery.

(22). From the Peripheral Battery two series of connecting media proceed; the first, the muscular nerves, or nerves supplied to the flesh; the second, the nerves distributed to the cutaneous textures. If we examine the nerve-fibres in recently-killed animals, we find that they consist of fine tubes containing a fluid, and lined with a peculiar species of fat, which may be obtained from their prolongation into the brain in large quantities, when the part is soaked in alcohol for a long period. In this structure we have all the conditions necessary to insulation, namely, a fine membranous tube lined with fat on its inner side, and containing a fluid in the centre; and such a structure, as far as electrical properties are concerned, would be analogous to a glass tube containing liquid.

(23). If we follow the course of the nerves, we find that they are prolonged to the brain, and end in the gray matter, where they again come in contact with a large quantity of blood-vessels. As the two series of nerves are not immediately connected in the brain, it follows, according to the laws of voltaic action, that another battery exists there, which may be termed the central battery.

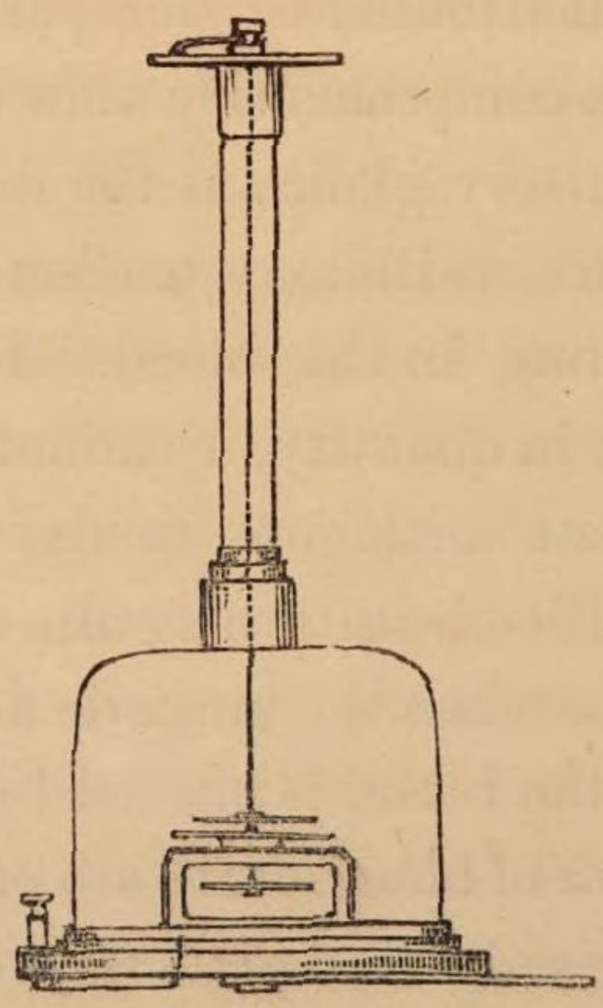
(24). For the continuance of animal life, it is necessary to have an integrity in the central and peripheral batteries; both requiring to be properly supplied with the normal exciting fluid, or blood. The poles of these respective batteries are connected by the nerves, to form one consistent whole, which I shall always hereafter mention under the term of Electro-biological circuit. For the integrity of this circuit, it is essential that the peripheral and central batteries be perfect, that their connection be maintained, and that a proper exciting fluid, or bright arterial blood, be distributed to each part.

(25). In taking a comprehensive view of Electro-Biology, we must also take a cursory glance at the different ways in which life may cease. Elcctro-Biology teaehes that death may occur from causes emanating in the blood. For instance, when the blood is insufficient in quantity, it cannot perfectly carry on the vital actions; a state analogous to the voltaic battery insufficiently charged. Blood-death may also ensue when its quality is interfered with, as when the lungs do not perform their duties properly, or when the blood is altered by the action of poisons; and the sub-divisions of blood-death are probably very numerous. Death may also arise from destruction of the parenchyma, as when either the peripheral or central battery is crushed. If the connecting medium be severed, as in the act of pithing, death instantaneously ensues. Lastly, we observe forms of death not included in the above, in which the bio-dynamic actions are interfered with, such as death by exhaustion or collapse, analogous to an exhausted battery; and death by coma, where all the functions of animal life cease one after another; a result

which may be obtained in the battery, when any cause stops the continuance of the action.

(26). Electro-Biology presents itself to our notice in several departments. We have first to study the peripheral battery, the positive pole of which may be termed the "Aisthenic Pole," because it is destined to receive impressions from the external world. Following the course of the nervous fibres, we trace the effect to the central point, or brain, the study of which will constitute the second division of our subject, or Electro-Noemics. We shall then proceed to trace the operations of the bio-dynamic force to the muscles and other organs of force; and lastly, we shall study the changes which occur in the batteries, under the term of "Bio-Electrolysis."

FIG. 1.



ASTATIC GALVANOMETER.

CHAPTER SECOND.

ELECTRO-AISTHENICS.

27, Electro-Aisthenics defined. — 28. Subdivision of. — 29. Sexual sense. — 30. Conditions necessary for Sensation. — 31. Organs of Sensation. — 32. The Eye. — 33. Retina. — 34, 35. Its supply of Blood. — 36, 37. Photo-Voltaic Battery. — Experiment. — 38, 39. Voltaic Current attending Vision. 40. Difficulty of Experimenting. — 41. Positive Photo-Voltaic Current generated. — 42. Poles in. — 43, 44, 45. Estimation of Colour by the Eye. — 46, 47. Opsaisthenic Poles. — 48. Negative Pole, Conjecture. — 49. Cognisance of Vision. — Electro-Ousaisthenics. — 51. The Ear. — 52, 53. Estimation of Pitch and Direction of Sounds. — 54. Formation of Voltaic Circuit. — 55. Artificial Voltaic Ear, — Suggestion. — 56. Poles. — 57. Taste. — Electro-Gumaisthenics. — 58. Voltaic Current. — 59. Smell in the Lower Animals. — 60. Elaborate Mechanism. — 61. Requisites for Scent. — 62. Circuit demonstrated. — 63. How produced. — 64. Artificial Voltaic Nose. — 65. Poles. — 66. Cænaisthenics defined. — 67. How brought into operation. Thermo-Voltaic Batteries. — 68. Effect of Cold on the Sensor Nerves. — 69. Voltaic Action generated. — 70. Imitation of the Effect. — 71. Comparative Sensibility of Portions of Surface. — 72. Circuit demonstrated. — 73. Pacinian Corpuscula. — 74. Conclusion of Cænaisthenics. — 75. Somaisthenics described. — 76. Cognisance by bodily feeling. — 77. Estimation of Motion. — 78. Sensor Nerves. — 79. Voltaic Circuit.

(27). ELECTRO-AISTHENICS is that department of Electro-Biology, which treats of the mechanism by which man, and in fact animals generally, receive impressions from the external world, and are made cognisant of the changes occurring within their own bodies. This department of physiological research is so extensive, that volumes have been written upon this subject alone; but it is not my intention to extend the

bulk of this Treatise more than is absolutely necessary, as the work is rather destined to indicate to the labourer a road which he may follow, than to map it out with that certainty which I trust hereafter the subject will obtain.

(28.) Electro-Aisthenics, then, comprises the study of all the various organs of sensation, as that of sight, or Opsaisthenics—of hearing, or Ousaisthenics—of taste, or Gumaisthenics—of smell, Rinaisthenics—of touch, or Cænaisthenics. After a most attentive consideration of the subject, I feel that Biology must admit one other sense, namely that of bodily feeling, or Somaisthenics. By this sense we obtain a knowledge of ourselves, and of the changes taking place in different parts of our own bodies, without which, I shall hereafter shew, that we could have no individuality, no personality, and could not even perhaps prove that our bodies did not belong to another individual.

(29.) Besides these senses, some physiologists have considered the sexual feeling as referable to another sense; but if carefully examined, it appears rather to be the result of a combination of sensations, the first set being derived from without, from the opposite sex; and the second being derived from actions occurring within the body itself. Hence the sexual sense is a combination of Cænaisthenics and Somaisthenics.

(30). For the manifestation of the phenomena of all these senses, two conditions are invariably necessary—the presence of a nervous expanse, and the supply of bright arterial blood to that expanse. The universal co-existence of blood and nerve constitutes the foundation of Electro-Biology, for we invariably find that blood is useless without nerve—nerve inactive without blood—both being requisite for the production of any of the varied phenomena of animal life.

(31). We thus perceive that the mechanism of the various organs of sensation, differs not so much in kind as in organic arrangement, for the reception of impressions from specific

physical forces. The eye is destined to be acted upon by an illuminated body or light; the ear by sound; the nose by odours; the palate by tastes; the skin by heat, cold or force; and the mechanism of bodily sensation by the changes taking place within our own bodies. In consequence of the mechanism of these various organs being different, it will be necessary to give a brief description of each separately.

ELECTRO-OPSAISTHENICS.

(32). I commenced my enquiries upon the mechanism of the senses with investigating the structure of the eye, because it is admitted by mankind to be the most important organ of sensation which human beings possess.

(33). In my treatise on Vision, I have considered the various phenomena in minute detail; and therefore in this work I shall confine my attention to the cause of vision. For the manifestation of this phenomenon there are two requisites; the presence of arterial blood, and the integrity of the retina. The retina is an expansion of the optic nerve, which penetrates the globe of the eye and forms a layer which has various degrees of sensibility, as the central part alone is adapted for the most perfect vision, the lateral portions being only capable of appreciating the general presence of objects. Vesicles, similar to those found in the brain, are connected with the retina; and in these spots it has been thought the action occurs.

(34). With regard to the supply of blood, we have to look to two sources; for we find arterial blood in the arteria centralis retinæ, and in the innumerable vessels of the choroid coat. The first artery is a delicate artery, running with its corresponding vein over the surface of the retina, or that part in contact with the vitreous body. There appears to me to be good ground for supposing that the artery is destined for the

nutrition of the vitreous body; and in fact it is much too small for the changes which constitute the act of vision.

(35). Besides this delicate vascular layer, there is another part highly charged with bloodvessels; and their wonderful ramifications are so beautiful and intricate, as to attract the attention and excite the amazement of the most casual observer. This vascular layer is called the choroid coat, and perhaps really constitutes the blood necessary to the retina, for various reasons. The vessels of this tunic are so arranged that the arterial trunks are situated near the retina, the veins behind, and out of the way; and, moreover, the capillaries are brought into contact with the retina; the larger branches being placed posteriorly. Furthermore, in the axis of the eye, where vision is most distinct, there this structure is found to be the most beautiful and intricate, and at that very precise spot the so called artery of the retina does not exist, but is so arranged as not to interfere or come in contact with it. I have prepared exquisite injections of both the retina and choroid, and a study of their characteristics forbids the idea that the artery of the retina would be sufficient to furnish the blood essential for vision.

(36). Blood and nerve being present, we have to observe in what manner action can be excited; and we find that the usual stimulus to the eye is light. The question now naturally arises whether it be possible to make a Photo-Voltaic battery. In the chapter on Electro-Biology, I explained that the conjunction of blood and nerve was probably equivalent to a material having an affinity for oxygen, placed in contact with a highly oxygenated solution. To imitate this condition, I placed the undermentioned solutions in a glass vessel, and inserted also into it two platinum poles, the one covered over with an opaque vessel* so that it might be in darkness; the other uncovered, that it might be freely exposed to the light of the sun.

* The bowl of a tobacco pipe inverted is found to be convenient for the purpose.

1. Mixed Solutions of Proto-sulphate of Iron and Nitrate of Silver.
2. Do. do. Gallic-acid and Nitrate of Silver.
3. Do. do. Oxalic-acid and Chloride of Gold.
4. Do. do. Ferrocyanate of Potash and Ammonia Per-citrate of Iron.
5. Do. do. do. do. Tartrate of Iron.
6. Do. do. do. do. Potassio-Tartrate of Iron.

Upon exposing the apparatus to intense light, the galvanometer was instantly deflected, shewing that the light had set in motion a voltaic current, which I propose to call a photo-voltaic circuit. In these instances, the platinum exposed to light, acted as the negative pole of a battery; and therefore this series I term negative photo-voltaic circuits. By using other solutions, for instance, those of per-nitrate of iron and red ferro-cyanate of potash, or of mixtures of Bromine water, phosphorus water, and per-nitrate of iron, a photo-voltaic circuit is generated in an opposite direction, and therefore I have designated them positive photo-voltaic circuit. In the negative photo-voltaic series there appears to be a tendency to the reduction of metals, which may be regarded as equivalent to the evolution of Hydrogen. In the positive series oxygen is evolved, which causes the current to act in the opposite direction.

(37). In the above experiments, it is manifest that the eye would present no extraordinary phenomena if it were a voltaic circuit where action was determined by the influence of light, as such a mechanism would be in conformity with ordinary physical phenomena, and obedient to ordinary physical laws. The question, however, is now to be decided, whether there is or is not a photo-voltaic circuit generated where vision occurs; and for the purpose of determining this point we must have recourse to the test which I have already, in the chapter on Electro-Biology, described under the term of an Electro-Voltaic Circuit.

(38). To apply this test to the eye, one needle should be thrust into the eye of an animal through the choroid coat; and

a second into the muscle in the neighbourhood; when if a sudden transition be made from darkness to strong light, a very slight deflection of the galvanometer declares the presence of a photo-voltaic current.

(39). There are unquestionably considerable difficulties in the operation; but by careful management and watching the oscillation of the needle, the current may be made decidedly appreciable. In estimating these effects, two tests are applicable; first, the motion of the needle in one direction; and secondly, the stopping of the oscillation of the needle when the current is reversed. A very feeble current may be ascertained with certainty by this manœuvre.

(40). In detailing the results of these experiments, I think it right to state that I have relied upon a multitude of trials. Sometimes I have utterly failed to produce any effect; at other times, I have been dissatisfied with my results; and it is only occasionally, when I have been fortunate enough to get an animal at his ease and in so little fear that he would be happy and comfortable during so unpleasant an operation, that I have succeeded in obtaining satisfactory results. It is a curious circumstance, that in no instance have I ever seen any permanent injury inflicted on an animal from this mode of treatment. I have caught strong, healthy cats, and subjected them to similar experiments, but they generally have been in such a terrible fright, from the confinement necessary to keep them quiet, that I could make no use of them for Electro-Biology.

(41). A positive photo-voltaic circuit is generated in the eye; that is to say, that the needle in the eye deflects the galvanometer in the same direction as though it were placed near the negative pole of the battery, and consequently would have the opposite condition induced in it.

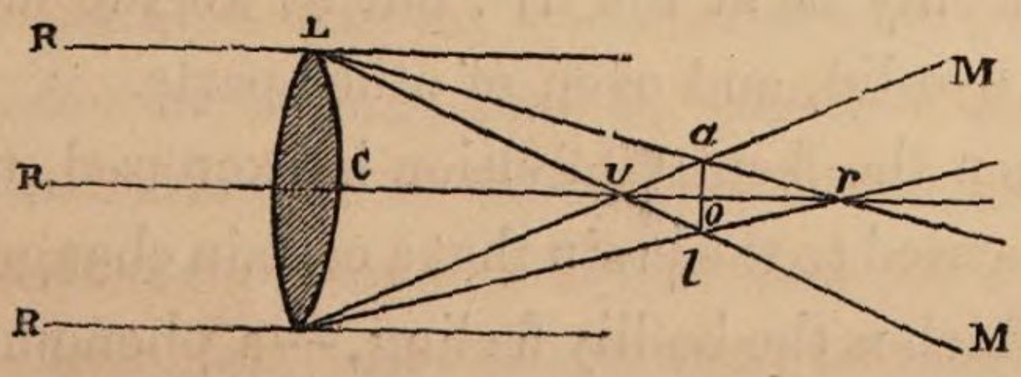
(42). Having found that the retina and blood of the choroid coat constitute one pole of the opsaisthenic battery, it is left for us to consider the position of the second; and I may state, that the nervous filaments supplied to the muscular structure

of the eye-ball and eye-lids form the opposite pole. In treating of Electro-Biology, I explained how each nervous fibril of one pole was opposed to a number of nervous fibrils in the other pole; and therefore it need not occupy our attention again at this place.

(43). It is an uncertain point, upon which Physiologists are not agreed, as to the means by which the mechanism of the eye enables us to estimate colour; that is to say, we do not know whether the three colours are carried as three separate impressions to the brain, or whether the three impressions are carried by one nerve to the brain, and are there analysed into their component parts.

(44). The phenomena of colour must depend upon a difference of action produced upon the retina by the three primary colours, of which Brewster has shewn the sum total of the spectrum to consist. Now, it has been demonstrated by Sir John Herschel and other observers, that the different colours have a diversity of powers to produce chemical changes; therefore it must follow that, by the three colours—red, yellow, blue,—a different intensity of action would arise. We thus find that in the perfection of nature's works, it would be within the range of physical laws to have photo-voltaic circuits which should only be excited by the respective coloured rays.

(45). As the three primary colours have different degrees of refrangibility, any arrangement by which the retina was made to consist of three layers, would enable us to have the most perfect estimate of colours—a proposition which may be understood by the next diagram. The red rays would collect at *r*, the violet at *v*. From this circumstance, we may be led to infer



that the retina has a certain depth, in the parts of which each

specific colour is brought to a focus. Such a contrivance will manifestly be the most perfect that could possibly be adopted.

(46). The extent of the retina which is serviceable for perfect vision, does not certainly exceed the 1-30th of an inch in diameter; for I find, by actual measurement, that it scarcely amounts to one-third of the insensible spot caused by the puncture of the optic nerve. I must refer my reader, for specific details upon these points, to my "Lectures on Vision," where my experiments are fully detailed. Now, if we could only tell how many points of definite magnitude we could observe at one time, we should be enabled to decide the number of opsaisthenic poles which exist in that part of the eye; but, at present, I have not succeeded in learning the fact.

(47). The essential structure of the eye consists in a definite number of distinct poles of the electro-biological batteries; and according as they are influenced by illuminated images, an action would occur in a sort of pattern, similar to that used by ladies for the designs of worsted work. At this point light loses its physical characters, and becomes aisthenic by its determining a voltaic circuit which acts upon the brain and gives a knowledge of the external world.

(48). Hitherto, we have only studied *one* pole of the opsaisthenic battery, and we have seen the aisthenic pole to be the retina and choroid. Upon the manner, however, in which the circuit is completed, I wish to speak with extreme diffidence, and wish Electro-Biologists to investigate it further. It is possible that the negative pole may be at the iris, as we find that the movements of the structure are regulated by the amount of action of the retina. It is also possible that the negative pole may not only be at the iris, but at all the muscles of the eye-ball and eye-lid, and even of other parts.

(49). When the faculty of vision is exercised, there is also a knowledge carried to the brain that a certain change has occurred in the eye, which is the bodily feeling,—a phenomenon which I consider more in detail hereafter, under the term of *Somaisthenics*.

(50). The mechanism by which we arrive at a knowledge of sound is not so well understood as that by which we are made acquainted with light; and, in fact, experiment cannot be brought to bear for the demonstration of its true and essential nature. However, all Physiologists are agreed, that the *seventh* nerve is the nerve which is acted upon by the impressions of sound, and this nerve is distributed to certain parts where we may infer, by analogy, that the ousaisthenic pole is situated.

(51). Sound is collected by the external ear, and inpinges upon the membrane of the tympanum, which is thereby thrown into vibrations. From this membrane it is continued to the inner ear, partly through a series of bones, and partly through the air. The inner ear, to which the ousaisthenic or auditory nerve is distributed, comprises three semi-circular canals, and a curious structure called the cochlea. To these parts, the blood-vessels and nerves are distributed. Without entering into long disquisitions on probable or possible modes of action, we may assume that the arrangement is of such a character as is suitable to allow the vibrations, according to the pitch, to act upon particular nerves; or, according to the direction from whence the sound originates, to influence particular localities.

(52). According to this view of the structure of the ear, the cochlea would be in reality one long, extended membrane, consisting of a number of nervous terminations, or ousaisthenic poles. The pitch of notes is probably determined by the cochlea; and therefore, if we could determine the length of the nervous membrane supplied to it, and ascertain the limits of hearing in that particular individual,—or, in other words, the highest and lowest notes which he could distinguish,—moreover, if we were acquainted with the minuteness with which he could distinguish different sounds, that is, whether the individual could determine variations of the eighth or the sixteenth of a tone, then we should be enabled to calculate the size and number of the ousaisthenic poles which give to man his ideas of pitch: for, according to the view which I have here given,

each specific sound of appreciable pitch has a certain specific and invariable locality in the cochleal membrane.

(53). The range of sounds appreciated by the human ear, consists of about 12½ octaves, and perhaps extends to the 32nd of a note, in those endowed with most perfect hearing. From this it follows, that the human ear can distinguish about 3,200 sounds; and therefore it would require 3,200 poles for that purpose. The means by which we distinguish the direction of sound appear to be more obscure, but probably they are learnt by various combinations of impressions in the semi-circular canals which are placed in the three dimensions of a cube, or, to use the geometrical phrase, in the three orthogonal planes of a cube.

(54). At first sight there certainly does appear much difficulty in constructing a voltaic circuit, which shall be acted upon by the vibration of sound. Upon consideration, however, that difficulty will not be found to be so great, for as the internal ear is enclosed in a solid unwieldy case, it follows that the part on which a vibration impinges, will have the delicate capillaries emptied of blood. From this result, according to the Bio-Electrolytic law, the oxygenated corpuscules would not be present at the termination of the nerve, and a voltaic circuit must of necessity be formed.

(55). We may merely, in a remote and imperfect manner, imitate such a state of things, and form an artificial ear, by fixing a piece of vellum over a glass vessel shaped like a funnel, and terminating in an inverted syphon. When the vellum is thrown into action, the water would be displaced in the tube, and as a consequence thereof, a circuit might be made or broken. By labour, I have no doubt but that a perfect acoustic telegraph could be made, which shall be acted upon by sounds, and have the power of transmitting them to any distance.

(56). The Ousaisthenic pole, or auditory nerve, has alone at present occupied our attention, and in all probability it

would be the positive pole. For the pole opposed to this, perhaps we may look to the muscles of the ear, or of other parts. Lastly, we must estimate the bodily feeling of hearing, namely, the amount or the intensity of sound, a phenomenon hereafter to be further considered.

ELECTRO-GUMAISTHENICS.

(57). Man is made but little acquainted with the external world by the organ of taste, although there is no reason to doubt that the mechanism of this sense corresponds with that of other departments of Electro-Aisthenics. Blood and nerve are both necessary for the manifestation of the phenomenon; and, reasoning by analogy, we may assume that the termination of the gustatory nerve forms the positive pole, though my direct experiments upon this point have been by no means satisfactory.

(58). We may make a voltaic battery, in which the circuit shall be determined by savours, in very different methods. For instance, if we place a little per-salt of iron, with two platina poles, in a **V** shaped tube, and then drop a little infusion of meat into one side, a voltaic circuit will instantly be produced. In nature, taste is probably excited by the absorption or contact of savours.

ELECTRO-RHINAISTHENICS.

(59). The human being can probably never become much acquainted with the nature of the various impressions which are obtained by animals through the medium of the nasal organ, because in man the sense of smelling is exceedingly imperfect.

(60). When we observe, however, the elaborate mechanism

of the turbinated bones of the cat, dog, and other creatures, the Electro-Biologist must admit, that such exquisitely complicated structures could not have been made in vain. The hound, which follows the hare for miles simply by the odour exhaled by its touch, possesses a sense of which man can form but little conception. Of the properties of odours we know but little; and whilst in some instances they depend upon material exhalations, in others they would rather seem to act as a mere force, and would justify a hypothesis of vibrations, a question which I have more particularly considered in my "Sources of Physics."

(61). Blood and nerve are necessary for scent. The olfactory nerve is distributed to the turbinated bones, and a most intricate layer of capillaries runs in the same situation to furnish a proper supply of arterial blood.

(62). To examine the mechanism of the nose experimentally, a needle should be thrust up the nasal organ,—an operation to which most animals have an extreme repugnance. The other needle should be inserted in the textures about the alæ nasi, and the scent may be excited by a little hydro-sulphuret of ammonia. The result of this experiment is often masked by secretions which interfere with the result; but, in good instances, the galvanic needle will be deflected as though the nose were the positive pole of the battery.

(63). The *modus operandi* of odours, in determining the circuit, is obscure, though the operation of hydro-carbons, camphor, oil of turpentine, sulphuretted hydrogen, and bi-sulphuret of carbon, may possibly be explained upon ordinary voltaic hypothesis; for, if we only suppose that they facilitate the reduction of the highly oxygenated blood, the voltaic current must be propelled to act.

(64). An artificial nose may very easily be formed to act with certain odours, such as ammonia; for, if we place two pieces of iron in a tube divided by a diaphragm to imitate a nose, and place each piece in contact with very dilute muriatic

acid, no current will arise. If to one pole, however, the fumes of ammonia be applied, polarity will be produced, and a voltaic circuit generated.

(65). The olfactory nerves would form the positive pole of the battery, and it must remain a matter of uncertainty to determine the exact position of the opposite pole, though in all probability the muscular structures of the alæ and face usually perform that function.

(66). The bodily sensation of the sense of smelling must also be considered in connection with the other phenomena; but that will be studied in a subsequent part of this chapter.

ELECTRO-CÆNAISTHENICS.

(67). The sense of feeling, properly so called, is much more circumscribed than it at first sight appears, because it is confounded with another sense which I shall describe hereafter, under the term of "Somaisthenics," or bodily feeling. The cænaisthesis is that feeling by which we derive certain impressions from without, and is never in our understandings confounded with a bodily feeling, or that sense by which we estimate the changes taking place within our own frame.

(68). Cænaisthesis is brought into action by the application of heat or cold; it is also brought into action by pressure, or other mechanical force. It is a perfectly simple and ordinary physical phenomenon for a voltaic circuit to be excited by temperature, a variety of battery to which I have assigned the term of a "Thermo-voltaic Battery." This form of circuit is of two kinds, positive and negative. In the positive thermo-voltaic circuit, the current is generated at the positive pole by the increase of temperature facilitating the chemical action; thus, if two pieces of iron wire be inserted in a V shaped tube containing water, with a trace of sulphuric acid, and one leg

be exposed to the action of heat, the current will start from that point. In negative thermo-voltaic circuits, the heat produces such actions as to cause the current to start from the cooler part of the solution. The nature of these currents is so obvious when once explained, and so diversified, that I need hardly occupy the attention of experimenters further than to state, that I have observed at different times a large number of thermo-voltaic circuits.

(69). In the living body, cold probably acts upon the sensor nerves to determine the voltaic circuit, by diminishing the circulation in the capillaries; and any mode by which the supply of arterial blood would be interfered with, would cause the circulation of the voltaic force. Excess of cold ultimately stops action, as repair could not follow the consequent exhaustion.

(70). There is no difficulty in the consideration of a voltaic circuit excited by force; for if by pressure we prevent the arterial corpuscule from coming in contact with the nerve-fibre, action must arise, inasmuch as the balance would be destroyed, polarity would ensue, and action would take place.

(71). We may imitate this kind of circuit by very easy means. For instance, if we take two pieces of iron wire, and insert them in very dilute acid, no action ensues, when tested by the galvanometer. The same result is obtained if the blood corpuscule be imitated by taking a membrane containing a little nitrate of iron, and placing one such artificial corpuscule against such iron wire. As soon, however, as the artificial corpuscule is thrust aside from the pole, a very powerful current is generated, which has its origin at that pole where no corpuscule exists. This structure is strictly and perfectly analogous to the natural mechanism of the body.

(72). All parts of the surface of the body are eminently endued with blood-vessels to carry the blood necessary to cænaisthesis. The sentient nerves, which are regarded as the aisthenic pole, are distributed close to this situation. Feeling,

however, is not equally acute in all regions; the lips, the tops of the fingers and toes, and some other parts being far more highly endued with sensibility than other portions of the body. This difference of sensibility exhibits itself in two ways; either a less amount of heat or force may cause feeling; or a smaller amount of both may have the same effect, which latter property is owing to a less frequent distribution of the ultimate nerve fibres, and consequent less numerous aisthenic poles.

(73). The determination of the course of the voltaic current is extremely easy, if the cænaisthesis is the subject of experiment. We have only to introduce one needle into the muscular tissue, and a second under the cutaneous structure, when a distinct current is immediately manifested in the galvanometer, when the animal is pinched or otherwise irritated. From this experiment we learn that the cænaisthenic pole is positive—the muscle, negative. Of course, the electro-voltaic current, by which we render manifest this phenomenon, is in the reverse direction.

(74). The animals which I have found best adapted to these experiments, are rabbits, for they are usually so tame as not to be incommoded by our operations. The eel also answers well, and exhibits the effects when it is either pinched or irritated.

(75). Blood and nerve are requisite for cænaisthesis, but the precise mechanism is still but imperfectly understood. Within the last few years, curious structures have been discovered over the whole course of the sensor nerves, which have been termed the Pacinian corpuscules. These singular appendages contain both artery and nerve, and consequently possess all the requisites for one pole of the battery; and there is a fair probability in the assumption that they are really the true aisthenic poles, or positive poles of the peripheral battery.

(76). Having concluded the mechanism of cænaisthesis, I have now described all the means by which man is made

acquainted with the external world, namely, by the specific organisations of the eye, the ear, the nose, the mouth, and the skin. All these organs agree in constituting the positive pole of the great peripheral battery of the Electro-biological circuit.

ELECTRO-SOMAISTHENICS.

(77). Man, however, is not only acquainted with the external world through the medium of the senses already described, but he also knows, to a certain extent, the changes which are taking place in his own body; a knowledge of the very utmost importance, in estimating the human powers. This power I shall here describe under the term, "Somaisthenics," which means nothing more nor less than bodily feeling; and under that term we shall study the mechanism by which we estimate our bodily changes.

(78). By Somaisthesis we appreciate the most minute muscular movement, for we cannot move any muscle even to the slightest extent without being conscious of it; and this knowledge of the extent of motion gives us a multitude of ideas. In my treatise on Vision, I have shown that our knowledge of distance, of magnitude, of form, and of many other phenomena, depends upon an exact appreciation of the movements of the muscles which direct the eye-ball. We obtain a somewhat similar knowledge by an estimate of the movements of the hand; and it is remarkable to what extent we obtain know. ledge by an intimate acquaintance with minute muscular movements. The sense of touch is derived principally from a knowledge of these minute changes.

(79). In my work on Vision before quoted, I have hazarded a conjecture that this sense of motion is derived from the motor nerves; but subsequent experiments and observations have

tended to shew that this sense depends upon the sensor nerves; and that, therefore, when the mechanism of motion is, comparatively speaking, perfect, no sense of the amount of motion exists while feeling is defective.

(80). The mechanism of Somaisthesis is not very plain, though I have ascertained that it does not exist when injury has been inflicted on the cutaneous tissues in a situation where the nerves of feeling are distributed. I know a gentleman who has sustained an injury in one finger, which has more or less impaired the sensation of the part to external influences. In his case he is also unable to judge of muscular power employed in the deflection of that finger, shewing that although the muscle is at a long distance from the sensor nerve, yet this latter carries the idea to the brain.

(81). It must remain a question for further consideration, whether a separate set of nerves are required for bodily feeling, or whether this function is performed by the cænaisthenic nerves. It is manifest that no difficulty surrounds the consideration of the voltaic mechanism of the somaisthenic pole; for as we can have no motion without force acting upon certain parts, it is certain that this force might prevent the arterial blood from coming in conjunction with the nerve, and thus a circuit would be generated.

CHAPTER THIRD.

ELECTRO-NOEMICS.

VOLTAIC MECHANISM OF THE BRAIN.

82. Central Battery or Brain.—83. Connection with Peripheral Battery.—84. Syndramics.—85. Aisthenic Noemics: Syndramic Noemics.—86. Pneuma Noemics.—87. Noemic Syndramics.—88. Complexity of the subject.—89. Brain, its Muscular and Nervous Structure.—90. Injected preparations.—91. Memory.—92 and 93. Illustrated voltaically.—94. Activity or Passiveness of Mental Functions.—95. Repetition of Peripheral Battery in the Brain.—96. Terminations of the Aisthenic Nerves in the Brain.—97. Negative Pole of Noemic Battery.—98. Repetition voltaically shewn.—99. Brain, a Double Organ.—100. Commissures.—101. Voltaic Imitation of.—102. Cells in the Gray Matter.—103. Syndramics.—104. Elaborate Structure of Brain.—105. Syndramic Battery: Poles.—106. Voltaic Imitation.—107 and 108. Intercommunication of Fibres.—109 and 110. Commissures, Corpus Callosum Cerebellum, Cerebrum, Olfactory Ganglia.—111. Aisthenic Noemics.—112. Poles.—113. Syndramic Noemics Defined.—114. Pnemo-Noemic Battery.—115. Defined; its Poles.—116. Its Situation in the Brain.—117. Desire a Voltaic Phenomena.—118. Regulating Laws.—119. Modus Operandi of Batteries throughout; Extreme Action of Pnemo-Noemic Battery.—120. Idea of Space.—121. Idea of Time.—122. Sensation of Pleasure.—123. Pain.—124. Effect of Extreme Impressions: voltaic Illustration.

(82). HAVING considered the mechanism of the aisthenic part or positive pole of the peripheral battery, we are led, in the natural order of events, to study the changes which take place in the central battery or brain.

(83). Each sensor or aisthenic nerve terminates in the vascular tissue or gray matter, from which, and other reasons, we may infer that the peripheral battery is simply repeated in the

central. This repetition of impressions in the brain may be called phreno-aisthenics.

(84). But as man receives ordinarily many impressions at the same time, and as he clearly remembers combined impressions, it will be necessary to assume a second structure, in which these combinations occur, which part of the subject I term Syndramics.

(85). Further, the sum total of the impressions of each separate sense gives us but one idea, such as that of sight, from all things we see; of hearing, from all things we hear. It follows that we must possess a mechanism capable of affording this, which structure I shall consider under the term of Aisthenic-Noemics.

We, moreover, have ideas which we derive from combined senses, the study of the structure of which I have termed Syndramic-Noemics.

(86). In the human being, we must have some structure from which we derive our notions of infinity; and to the consideration of this I have assigned the term of Pneuma-Noemics.

(87). Lastly, we have to consider from whence the impulse is sent for the brain to cause action; a study which may be conveniently followed under the term of Noemic-Dynamics.

(88). The mechanism which we have to consider is, therefore, abundantly complex; because, an impression communicated to any aisthenic filament would, as a general proposition, at certain times, excite any dynamic nerve in the body to action. The details are therefore exceedingly difficult to comprehend in all their minutiæ; and yet I trust, by passing gradually from the simple to the complex, the leading features of this wonderful and intricate apparatus will be developed: and though the exemplification of the structure of a single brain would occupy many acres, I can exhibit examples of the mode of acting in the several departments by ordinary voltaic combinations, which I shall hereafter describe.

(89). The requisites of action, blood and nerve, are found in sufficient abundance in the central battery or brain, as that

organ is literally nothing but fibres and blood-vessels. The nervous fibres are so numerous, that no estimation could be given of the myriads of which the brain is composed; in fact, the whole of the white matter of the brain is composed of nerve tubes. The blood-vessels are distributed to the gray matter in all parts of the brain, which presents a truly wonderful example of vascular structure when perfectly injected.

(90). I have been enabled to make the most beautiful injections of the brain and spinal marrow which have ever been executed, by using an injection consisting of carmine dissolved in ammonia, and mixed with a solution of isinglass. This injection is of an intense colour, perfectly fluid, and is thus enabled to penetrate the minutest ramifications of the capillary vessels. In injecting the brain, it is necessary to use one that is perfectly fresh; and I generally inject immediately after the animal is killed. By these means the most exquisite injections of the brain and spinal chord have been executed; and in all my preparations it is shewn, that wherever gray matter exists the blood is distributed, and where the white matter exists there is no blood; and from these considerations, physiologists infer that the gray matter is the active part of the brain.

ELECTRO-PNEMONICS.

MEMORY A VOLTAIC PHENOMENON.

(91). When a man receives an impression, it is not evanescent, passing immediately away, but it is retained in the system to regulate future actions. Now, in voltaic constructions, it is not difficult to produce an action which shall influence future motions, and thus exhibit the effects of memory.

(92). If we take two iron wires, and place them in a solu-

tion of argento-cyanide of potassium, and direct a voltaic current through them, silver would be reduced at that wire constituting the negative pole. The two wires would be ever afterwards in different electric relations to each other; one would be positive, the other negative; and thus the effects of memory would be shewn, and future actions regulated.

(93). I think it quite superfluous in this work, to give a multiplicity of instances of a similar character; otherwise, I could record a multitude of cases in which changes are produced at the poles, or upon the fluid which should give a persistant effect and exhibit all the properties of memory, which is well known to all pathologists to be entirely a physical phenomenon arising from some change taking place in the sensorium itself, and which is influenced by all causes interfering with the action of the brain.

(94). Now a question arises as to whether electro-pnemonics is an active or a passive property—for we may have either in a voltaic combination. We may have a passive result of memory, where the facility of the passage of electricity is interfered with, as where an ordinary battery is surcharged with sulphate of zinc. We may have an *active* memory, as in the first experiment detailed, or when any circumstance is produced competent to effect a persistant polarity. As, however, the most acute observers agree in assigning a spontaneity or activity to thought, we may infer that where the electro-noemic batteries are thrown into action, an impression arises which, at some future time, may produce results according to laws hereafter to be detailed.

PHRENO-AISTHENICS.

THE RECEPTION OF UNITS OF SENSATION.

(95). The mechanism of the peripheral battery is repeated

in the central; that is to say, for every active point in the body, an active point exists in the brain. For the locality where each action is repeated in the brain, we must have recourse to anatomy, and must trace each separate filament to its termination in the gray matter; and we find that the cænaisthenic nerves emanating from the spinal marrow are prolonged into the cerebellum. From this fact, it would be apparent that a division of the peduncles of the cerebellum on one side, would determine a motion towards the opposite,—a fact which actually occurs in nature: for of all the singular physiological effects which can be produced, there is none more remarkable than the continued revolution of an animal thus injured.

(96). The phreno-telegraphs or nerves of the nose terminate in the olfactory lobe, which is enormously larger in animals than in man. The optic nerves pass to the *corpus geniculatum externum* and *internum:* those of the ear, to the *calamus scriptorius.* Much, however, as the labours of modern anatomists have done to increase our knowledge of the structure of the brain, the exact situations at which each aisthenic nerve, or even of each class of nerves, terminate, is by no means certain.

(97). All the nervous fibres terminate in the vesicles of the gray matter, and thus come in contact with the blood-vessels, where they would form one pole of the noemic battery. As this pole alternates with the aisthenic, or sensor pole of the body, which we have already found to be positive, the laws of electricity teach that this pole would be negative; but probably it will for ever be impossible to devise any experiment which shall directly determine the point in the body itself.

(98). An analogical arrangement may easily be found in voltaic experiments, where the actions of one battery are repeated in the second; for instance, if we take an ordinary battery, and attach it to a precipitating trough, similar to that employed for the reduction of metals in electro-metallurgic experiments, the latter cannot act without the former; and when the former is thrown into action, an action precisely

equivalent takes place in the other. The electrical resistance produced by such a combination may be extremely slight.

(99). The entire body, then, is first repeated in the brain, nerve for nerve, action for action; and in this way we obtain the idea of units of sensation. In the perfection of nature, we may assume that each pole equally conduccs to the production of mental phenomena. I have already mentioned at the commencement of this chapter, that there are strong reasons to suppose the brain is a double organ, and moreover, that two impressions, one received on each side of the body, give but one idea to the mind. To preserve this doubleness of the apparatus, that is to say, to have the actions in duplicate, each fibre must be connected with the corresponding fibre in the opposite side of the body. From these considerations, I apprehend that the second pole of the phreno-aisthenic battery, which would be positive in its electrical arrangements, is used for these commissural purposes.

(100). By this communication, two distinct systems of apparatus are formed, of which one is but the duplicate of the other, so that any action taking place on one side would be manifested on both. This connection is doubtless effected in the brain by the so-called commissures, though much labour is still required to be bestowed by the anatomist to follow out the fibres of each respective sense. The mode of arrangement appears to vary in certain parts; for in some cases, as in vision, a very peculiar contrivance is found in the commissure of the optic nerve. Here, the two inner portions probably divide, and one part continues its own course, while the other passes to its neighbour. In this way, the sum total of the field of vision will be represented on each side of the brain.

(101). The commissure, which we may, for anatomical considerations, reasonably expect to exist in the human brain, may be readily imitated in voltaic arrangements; for if we connect together the negative plates of two decomposition troughs, which are excited each by its own separate voltaic battery.

the same result will be obtained. The consequences of this commissure are important; for if any second trough follow in series, both sides would be equally excited if either battery acted. In the brain, after the first commissure, any action in the body will act in duplicate.

(102). Throughout the gray matter, or active part of the brain, minute cells are formed, which may be supposed to be the poles of the central batteries. A question arises whether it be necessary for each cell to be insulated. These cells are so diminutive, that no physiologist can ever hope to be accurately informed upon all the changes going on within them, but from the law which I have developed in my work on Electro-Metallurgy, that the voltaic circuit is completed through the easiest road, to the exclusion of all the rest, no such insulation will be required.

THE COMBINATION OF SINGLE IMPRESSIONS OF EACH SENSE.

(103). Man, however, is cognisant of associated impressions; and, moreover, the action of the brain clearly indicates that the primitive fibres are associated together in various manners. This combination may conveniently be studied under the term, "Syndramics." Every possible combination of the single impressions of each fibre of the respective organs of sensation must necessarily occupy vast bulk, and must require a multitude of fibres, which circumstance gives us a reason for the vast size of the brain, and its multiplicity of fibres and vesicles. If we represent four simple elementary phreno-aisthenic terminations by A, b, c, d, we might have the following ten combinations of them:—A b, A c, A d, A b c, A b d, A b c d, b c, b d, b c d, c d.

(104). In nature, however, we should have to deal with perhaps 2,000 or 3,000 elements from each organ of sense, which would, of course, in combination, form many thousands; and yet with the extremely minute structure employed in the brain, that organ probably contains room for all the most important, when packed and arranged with the absolute perfection manifested in all the operations of nature.

(105). In treating of Phreno-Aisthenics, I stated that the first pole would be negative, the second positive; consequently in the Syndramic battery the first pole would again be negative. To give identity to these specific combinations, a nerve fibre must alternate with each combination, and this would again in its electrical arrangements be positive.

(106). We may imitate this combination of single impressions very readily by voltaic batteries. The best method is to use, for the last pole of three or more imitative Phreno-Aisthenic batteries, a piece of copper, to which several wires are soldered. These copper wires can be made into all possible combinations, to form the first pole of the Syndramic batteries.

(107). It appears to me not only unnecessary to assume that the sum total of all the fibres of the body should be connected together in every possible manner, but even that such an arrangement would be embarrassing and complicated to the mind. From various considerations, I am inclined to think that this combination is confined to all the fibres of each specific organ of sensation, and that single fibres of each sense do not combine with single fibres of other senses. However, the body, perhaps, as far as the sensor nerves are concerned, is mapped out into regions, between the parts of which alone the combination of simple impressions occur in the Syndramic battery. By such arrangement, it is manifest that the entire number of combinations will be much lessened in number, and the result will accord better with the ordinary properties of the mind.

(108). We have again reason for concluding, that this second pole is connected with the corresponding pole of the opposite side of the head—a commissural arrangement which would be similar to that described in the Phreno-Aisthenic battery.

(109). The exact situation of these commissures in nature is very imperfectly known; though, as this commissure must consist of a very large number of fibres, it would only be fair to assign this proud position to the *corpus callosum*, which all anatomists have agreed to consider as the great commissure of the brain. According to the extent to which these combinations are carried, so must be the required bulk of the commissural apparatus. Perhaps, with our present knowledge, it would not be too much to assign to the cerebellum the office of not only receiving, but combining the impressions of common sensation or ordinary feeling.

(110). To the convolutions of the cerebrum, in like manner, may be assigned a similar office with regard to the nerves of the special senses, except those of the nose, which we may suppose to be combined in the olfactory ganglion, which is diminutive in man, but of enormous bulk in many animals. The various parts of the Syndramic battery, from its vast size, must necessarily occupy the largest part of the brain.

AISTHENIC NOEMICS.

ULTIMATE ASSOCIATION OF IMPRESSIONS OF EACH SENSE.

(111). The human species has cognisance not only of single sentient impressions, and of combined sentient impressions, but we also derive a single idea from the sum total of all the impressions of each sense. As this property appears to belong to man alone, and is consequently a proof of mental power, I have termed this part of the subject Aisthenic Noemics. To

obtain a single impression from a multitude of separate actions, it is only necessary, in voltaic arrangements, to connect all the combined arrangements, so that they may act in a single battery, which single battery will exhibit action, whether one or all of the former batteries were excited. In this way the idea of sight will be given when any of the optic nerves are acted on; of hearing, when any of the auditory nerves; of smelling, when any of the olfactory nerves evince action; and in like manner for the other sentient nerves.

(112). As the second pole of the last battery was positive, the first of this will be negative. The pole opposed to this will again be positive; and here, again, we are led to expect another commissure, as before, with similar actions, on the other side of the body, otherwise we shall have two ideas of sight, hearing, etc. This battery cannot, from its nature, be very great in extent, and is probably situated deep down in the central parts of the brain.

SYNDRAMIC NOEMICS,

OR, COMBINATION OF ASSOCIATED IMPRESSIONS OF DIFFERENT SENSES.

(113). There certainly appears ample grounds for supposing, that the simple impressions derived from the sum total of the nerves of each sense are combined together in a manner precisely similar to that described in Syndramics. I need not in this place again refer to the structure necessary for such an arrangement, but shall content myself with observing, that the effect of such a contrivance in the human body will be to give us an idea of those properties of bodies which we derive from two or more organs of sensation at one time. When, for instance, we see a body, we associate all its properties, as far as they can in any way affect our senses.

This battery would occupy but small space, and is probably placed near the meso-cephale.

PNEUMA-NOEMICS.

TOTALITY OF ALL IMPRESSIONS.

(114). In man, it is imperatively necessary to assume a mechanism which shall collect the ultimate combinations of the respective senses into one whole. This mechanism I shall describe under the term of Pneuma-Noemics, because it appears to be that structure which gives to man the idea of infinity.

(115). Such a structure would be similar in every respect to the Aisthenic-Noemic battery, and therefore need not again be described in this place. The first pole, following the laws of voltaic action, would again be negative. Its opposed pole is in the highest degree important, inasmuch as, at that point, the motor or dynamic nerves spring.

(116). The position of this battery is somewhere in the centre of the Pons Varolii; and when I have plunged a needle into that situation on one or two occasions, I believe that I have observed deflection in the galvanometer. The animal has been, however, invariably killed; and therefore I have not been able to repeat this experiment so often as I could otherwise desire, nor could I judge of the result in so satisfactory a manner, as to pronounce positively upon it.

This completes the structure of the brain, as inferred from voltaic laws; and it is now manifest, that every structure here assumed may be imitated and repeated by voltaic combinations.

DESIRE, A VOLTAIC PHENOMENON.

(117). The faculty of desiring resolves itself into a tendency to act, and is manifested when the central batteries are in a condition of excitement. Desire is to mental operations similar in all respects to tension in electric arrangements. When the desire is gratified it ceases for a time. This phenomenon is similar to an exhausted battery, in which arrangements exist for replenishing the exciting fluid; as in this case, after a time, the battery would again become active and exhibit tension, which I have, in my sources of physics, described as a desire for action ungratified.

LAWS REGULATING THE ACTION OF THE CENTRAL BATTERIES.

(118). It is manifest, by this arrangement, that any circumstance determining the action of the fibres of the aisthenic battery would, or might influence the whole upon certain laws.

1. Each sensor or aisthenic nerve, is opposed to every motor or dynamic nerve, and may thus excite it to action.
2. This circuit would be completed through the nearest motor nerve of the body, because that would be the readiest course, unless there were obstacles offered in some part of that circuit, or adjuvants added to other parts.
3. If any obstacles were offered in any part of the course, the circuit would be completed by some other motor nerve, according to the facility with which the current could pass.

(119). When an aisthenic nerve is excited, it gives a unit of action in the phreno-aisthenic battery; it will influence all

the combinations into which the unit enters in the syndramic battery; it will influence the aisthenic-noemic battery; after which the impression would act upon the combinations of the syndramic-noemic battery, into which that specific sense enters; and lastly, it would be manifest in the pneuma-noemic battery. Thus, the impressions in the phreno-aisthenic battery give us the number. In the syndramic battery we arrive at the form; in the aisthenic-noemic battery we are made acquainted with the organ of sense by which we learned the impression. If more than one sense was excited, it would be learned in the symdramic-noemic battery; and lastly, the pneuma-noemic battery would be acted upon.

(120). In my last illustration, I shewed how an aisthenic impression passed through the brain. I have now briefly to state how a pnemonic impression would act upon the same organ. I think that we may assume that memory probably resides in the largest battery of the brain, or the syndramic battery. If an impression appears in that situation, it will influence the parts of the phreno-aisthenic battery of which it is composed, and probably the aisthenic-noemic, the symdramic-noemic, and the pneuma-noemic batteries will be acted upon.

(121). If a very strong action were made upon the pneuma-noemic battery, it would influence every nerve of the body; and if it were so great as to exhaust them, life would become extinct. It is thus, doubtless, that strong moral emotions instantly destroy vitality.

(122). In the brain, we thus have a mechanism to learn units of sensation, combination of units of sensation; specific sensation, the combination of specific sensation, and totality of all sensation. All these effects have relation to extent; and the infinity or totality of extent may be regarded as the only idea we form of space.

(123). But two or more series of impressions are continually

occurring in man; and whilst one combination remains constant, another changes; and from this relation of the changing to the persistant, the idea of time is deduced. The various effects of time, with regard to impressions of like senses, are manifested in the syndramic battery; those of different senses in the noemic battery, of different combinations of senses in the syndramic-noemic battery; and lastly, in the pneuma-noemic battery we have the idea of absolute concurrence, or "All Time."

(124). When an impression acts upon the phreno-aisthenic battery, it may be of various amounts, which determine its different degrees of action. An impression, up to a certain point, appears to give rise to action by the nearest course; and wherever action takes place, it is found to give us the idea of pleasure, which, in the lower battery, constitutes specific pleasure; when conjoined with the pneuma-noemic battery, absolute pleasure.

(125). On the contrary, however, if beyond a certain amount, exhaustion occurs; the voltaic circuit cannot be maintained in its proper course, and pain arises, which, in the lower batteries, appears as specific pain; and conjoined with the higher, as absolute pain. The transition from pleasure to pain is perfectly sudden. An impression is made upon any part of the body with a pleasurable result up to a certain pitch; but beyond that, pain immediately ensues.

(126). I might, in the present place, dilate largely upon the mechanism by which pleasure and pain may be regulated; but it will be sufficient to give a single illustration of the most simple method, in which, in the voltaic circuit, a strong impression might stop action. If a very minute piece of metal be placed in a glass of fluid, as a positive pole, and a large current be passed through it, the metal would instantly be dissolved, and the circuit could not be completed by that road. What is true of solid poles, is true of liquid poles, or intervening fluid; and where repair is constantly necessary, as we know it is in the brain, a strong impression would more than

equal the ordinary supply, and thus, action, through that combination, would be stopped. The effect upon the brain by a painful impression, appears to amount to more than mere exhaustion, as the part seems damaged permanently, and the action through that road does not again readily take place.

CHAPTER FOURTH.

ELECTRO-PSYCHOLOGY.

PROPERTIES OF THE MIND, DEDUCED FROM THE VOLTAIC STRUCTURE OF THE BRAIN.

127. Units of Sensation.—128. Combinations of Senses; Syndramic Battery.—129. Ideas obtained from the Aisthenic-Noemic Battery.—130. Impressions from the Syndramic-Noemic Battery.—131. From the Pneuma-Noemic Battery.—132. Thought.—133. Memory and Fancy.—134. Source of our Ideas of Infinity, Space, Good, Evil, etc., etc.—135. Results of Organisation.—136. Free-Agency, and its Modifications.—137, 138. Crime and Punishment.—139. Regulation of Actions.—140. Moral Law.—141. Conscience.—142. Religion.—144. Religion and Science.

(127). THE knowledge of external objects, and of the changes taking place within our own bodies, is limited by the units of sensation; for anything which cannot effect an unit of sensation, is inappreciable. Quantity of matter is in like manmer known by the number of units of sensation excited. The phreno-aisthenic battery gives a limit to our knowledge. The phreno-aisthenic battery would also shew, like the keys of a piano-forte, whether two or more nerves were acted upon at the same moment. It therefore makes concurrence.

(128). We have the power of recognising combinations of each sense and region separately, by the syndramic battery; we also obtain concurrence of compound impressions of different senses, or of different regions of the body. By the concurrence, or discurrence of impressions of like senses, or by the concurrence or

discurrence of combined impressions, we obtain the notions of the specific time of each event. In the same way that we obtain our notions of specific time, so do we obtain the idea of cause and effect; though, unquestionably, it is far more difficult to learn absolutely the cause, as the time of an event. Specific action and prevented action, which produce pleasure and pain, must also be sought in this battery. In the syndramic battery, Memory also probably resides. In consequence of the probable active nature of memory, it may be inferred that here, when an event is impressed, it rises hereafter to excite future action.

(129). By the aisthenic-noemic battery, the idea of vision is obtained, in consequence of its giving us the cognisance of the totality of the impressions of the eye; the idea of hearing from those of the ear; taste, from those of the palate; odour, from those of the nose; feeling, from those of the skin; and personality, from those of bodily feeling.

(130). Man can obtain ideas of two or more senses at one time by the syndramic-noemic battery; as, for instance, when we regard a solid body, the idea of solidity is derived not only from the eye, but from touch. This battery also enables us to ascertain the concurrence or discurrence of impressions received by two or more of the organs of sense at one time.

(131). Man derives his most exalted ideas from the pneuma-noemic battery; for all impressions here act as unity, and give us the idea of space. All concur, giving us the idea of all time: in fact, this battery gives to man his idea of infinity. If we descend into the aisthenic-noemic battery, the idea of infinity loses its characteristics, and the impression is limited to the totality of the specific senses. If we descend from the totality of the specific senses into the combination or syndramic battery, the impression is limited to some combination of a particular sense or region of the body; and if from this we descend to the phreno-aisthenic battery, we obtain the exact number of units which have affected us.

(132). The mind, however, derives certain powers from combinations of two or three of these batteries conjointly. We obtain the ideas of a thought and of a reality in this manner. An idea is a thought when the bodily action does not concur with the combination which appears to the mind. An idea is a reality if these two combinations do concur. There are times, when indulging in the spontaneous thoughts of the mind, that a question arises to ourselves, whether everything around us is not a dream—a fanciful creation of the mind; and in such a state we are led to doubt whether it be possible to prove our very existence; but the moment we ascertain whether actions of thought concur with actions in the body, the difficulty ceases, and we are enabled to distinguish immediately between a reality and a fanciful creation of the brain. This power is termed Consciousness.

(133). The recurrence of by-gone impressions, gives to us the power of fancy, and therefore we find at once that fiction and fancy can only unite impressions which have occurred at some former time, with some other series of occurrences at other times. Observation, therefore, is the basis of fancy; and a novelist is fruitful in proportion as he notices surrounding objects. He cannot create; he can only put together parts or impressions which he has derived from without. Man, however, having the power of analysing a compound impression into the parts of which it is made up, may again combine its component parts in every other possible manner.

(134). Other combinations doubtless give us other ideas; thus personality and infinity give us the idea of the soul; pleasure and infinity, of good; pain and infinity, of bad; cause and infinity, of God; time and infinity, of eternity; infinity, pleasure, and time, of heaven; infinity, pain, and time, of hell. Personality and all the units of sensation give us the idea of the body; personality, infinity, and time, of immortality. Personality and other totalities of senses, give us the idea of the mind; thought and infinity, of spirit. Lastly, action, infinity,

and pleasure conjoined, give us the idea of virtue; action, infinity, and pain, of vice.

(135). Thus, we perceive that we know from the very organisation of our bodies, that we are immortal; that God exists; that there is virtue and vice,—a heaven and a hell. Man, in every age, in every climate, is compelled, by his very organisation, to believe these first principles. It is not within our power to define these ideas; and if we attempt to descend into particulars upon these mental conceptions, very different specific ideas are attached to the same point. That which is infinite, must not be limited; time must not be confounded with eternity, matter with space, the body with the soul, or material actions with God.

(136). Electro-noemics indicate that man, at the beginning, is perfectly free to act in any manner from external impressions; but after he has once received impressions, these also regulate his future proceedings. He is then necessitated to act well, if he has received good impressions, — badly, if he has received evil impressions. In fact, electro-noemics indicate the fundamental principle of education, for they teach that if you "train up a child in the way he should go, when he is old he will not depart from it."

(137). Electro-noemics should be the basis of jurisprudence. It shews that crime and pain should be associated together at the same time, because a stronger result would attend punishment inflicted the moment the crime was about to commence. Such a course is suitable for the lowest intellects, or persons of the lowest mental capacity. When, however, good principles could be effectively instilled, they would control every action, and prove far more useful.

(138). Electro-noemics also shew, that to produce a strong effect in future actions, a strong impression must be left on the brain. From this cause, punishment should be inflicted upon a man in a healthy, vigorous condition, and neither ill-fed nor debased in energy; otherwise the impression would be transient

or evanescent, and would not deter the party from the commission of future crime. Electro-noemics also indicate that slight and proportionate punishment invariably following crime, would have more effect than severer punishment, with less chance of its infliction.

(139). Moral Philosophy receives many elucidations from Electro-Noemics, as it indicates that there are two modes by which our actions are regulated, the one according to the immediate and bygone specific impressions, the other by general laws overruling every specific action.

(140). The moral law is infinite, and being manifested in the pneuma-noemic battery, rules every specific instance; and hence the desire for virtue would prevent any vicious act. In the lower battery, action will be determined entirely from the pleasure or pain of the immediate impressions; but these actions are controlled by the ideas of infinite pleasure in the higher battery. Hence, from having the idea that virtue leads to infinite happiness strongly impressed on the mind, a vicious action will be controlled even at the greatest immediate pain. On this account martyrs have suffered the most excruciating agony, rather than do that which they believed to be wrong.

(141). When the moral law is but feebly imprinted on the brain, the immediate impression is not controlled, and the man acts according to the pleasure and pain of the particular impression. If the actions deduced from the moral law and those from direct impressions do not coincide, we are conscious that the action has been wrong. This power to distinguish whether the specific action concurs with the moral law we call Conscience.

(142). Religion is the basis of moral laws; and all religions, true or false, are assumed to come direct from God. Religions, whether true or false, have the same effect in controlling the actions from the influence of the higher batteries. The Indian suttee destroys her body under the influence of a

debased religion, in the same manner as the Christian sacrifices his frame, and endures agonising tortures. From these considerations, man is taught the importance of religion; and, *a fortiori*, the necessity that this religion should be a pure, a holy, and an undefiled religion.

(144). The teachers of religion, and the teachers of science, affect the mind through the two opposite extremes of the Electro-Noemic batteries. The former influence men from general principles to control each specific act. The latter trace up specific impressions to general laws. As the mind acts in a circuit, the two courses, although opposite, cannot be contradictory. When, therefore, the teachers of science and the teachers of religion differ, one or both must be in error, as truth, on both sides, must lead to an absolute concurrence in its effects. For ever, then, let these two great teachers of man act in concert, and let them be assured that at last both will arrive, although by opposite methods, at the selfsame absolute truth, which it is the delight of man to attain.

CHAPTER FIFTH.

ELECTRO-BIO-DYNAMICS.

OR, THE FORCES PRODUCED IN THE LIVING BODY.

145. Bio-Voltaic Circuit. — 146. Dynamic Nerves. — 147. Their Distributionl — Muscular Structure. — 148, 149. Muscular Motion. — 150, 151. Voltaic Imitation of Muscle. — 152. Power of Muscle. — 153. Compound Battery, probable existence of in Muscle. — 154. Conjecture. — 155. Circuit during Muscular Action. — 156. Continuous and Intermittent Currents. — 157, 158. Artificial Muscular Machine. — 159. Remark. — 160. Electrical Fishes. — 161. Generation of Electricity in. — 162, 163, 164, 165. Voltaically imitated. — Remarks. — 166. Adhesion of Hydrogen. — 167. Alternation of Electrical Condition of Cells. — 168. Bio-Photo-Dynamics. — Luminous Animals. — 169. Bio-Thermo-Dynamics. — Generation of Animal Heat. — 170. Morbid Increase of Temperature. — 171. Its Effects. — 172. Voltaic Analogy. — 173. Further instance of increased Heat.

(145). THE completion of the Bio-Voltaic circuit is through certain Dynamic nerves, which, passing to the flesh, produces Motion — to the electric batteries of certain fishes, produces Electricity — to the light-generating apparatus of animals, produces Light. Besides these forces, more or less heat is produced in most creatures.

(146). All the Dynamic nerves probably arise from the last pole of the Pneuma-Noemic battery, and, consequently, each nerve is opposed to every sensor nerve of the body. They are distributed to the various organs described as above. In every organ supplied by these nerves, the necessary amount of

blood abundantly exists; but in each tissue, the manner in which the capillaries are arranged differs, so that the practised anatomist can always instantly distinguish the tissue by an examination of the method in which these vessels are arranged.

(147). Nerves are distributed to all muscles, and the largest supply, according to my own observation, is awarded to the muscles of the eye. The muscular nerves terminate in loops running transversely to the general course of the muscular fibrils. The ultimate part of the flesh appears to be a simple sheath, containing a peculiar matter, which is the true sarcous tissue, or flesh. When the muscle is contracted, the internal matter may be broken into fibrillæ, which are apparently again composed of a series of globules or discs, which the anatomist considers, by the process of contraction, to become flatter, wider, and more approximated together. According, however, to my own observations upon this point, I do not believe that this structure exists in a thoroughly relaxed fibre, which has none of these markings. Perhaps it would be a nearer approximation to truth, to state that the ultimate fibrils contain a homogeneous substance, but that, during contraction, this globular or beaded appearance, is produced.

(148). The essence of muscular motion consists in a change in the arrangement or composition of the matter contained within the ultimate fibrils, so that they become wider and shorter, and by this shortening produce the effects of motion.

(149). Each muscular fibril is completely enveloped by blood-vessels, which run parallel to the fibrils. The supply of bright arterial blood is absolutely necessary for the manifestation of muscular motion, and, consequently, the relation of the capillaries should be fully borne in mind. A good mode of injecting the capillaries is by the exquisite carmine injection

before described, when treating of the mode of injecting the textures of the brain.

According to this view of the case, muscular contraction ensues from the material existing in the ultimate fibre being increased in bulk by changes taking place in consequence of the voltaic circuit.

(150). An artificial muscle may readily be constructed, to act upon a similar principle. To effect this object, the sheath of the ultimate fibre should be imitated by a bladder, or perhaps more strictly by a piece of the gut of any animal. Into the interior of this, a strip of platinised silver and a small quantity of sulphuric acid should be introduced. The gut or bladder should be tied round at both extremities by a piece of strong cord, which would close the apertures and serve for artificial tendons. The whole must then be immersed in dilute sulphuric acid, containing a positive pole of zinc. When the zinc and silver are connected, gas is evolved within the artificial muscular fibre, when it widens and shortens. This contraction acts upon the artificial tendons, to produce any required motive power.

(151). The contrivance just described represents only a single fibril; but in nature, a multitude of fibrils are associated together to form a single muscle. This mechanism can be readily imitated by using a number of pieces of gut associated together like the fibrils of muscle. In nature, of course, the matter distending the muscle must be immediately removed by the vessels,—an effect which in the artificial contrivance might be imitated either by mechanical expedients, allowing the escape of the gas, or by chemical substances causing its absorption.

(152). By both the artificial and natural arrangements, we obtain enormous power moving over a small space. For this reason, tendons are always attached, in the animal economy, to the small end of the lever, and so far play at a mechanical disadvantage: inasmuch, however, as the power is enormous, this disadvantage is of no practical inconvenience.

(153). Considering the vast power of muscular fibre produced from the small amount of voltaic force necessary to cause its action, it has occurred to me that in certain cases, muscle may be a compound battery cell such as we take advantage of in electro-metallurgy, for obtaining many equivalents of results from one equivalent of force. We have alternately blood-vessels and ultimate sarcous fibre, every alternation of which might form one voltaic cell. With this view, as the amount of action would be equal in all the cells, it follows that a great many equivalents of action would arise from one equivalent of voltaic power. We may imitate such an arrangement by using a series of iron plates interposed between the terminal poles of a battery, when we shall obtain as many equivalents of power, as we use iron plates.

(154). Muscular substance is naturally acid, but being the negative pole of the peripheral battery, a certain amount of alkali would be set free during action. Now a question arises "Whether the alkali coming in contact with the sarcous material, may not contribute to the effect?" and this view is supported by the fact, that muscular fibre, placed in a solution of potash, swells and contracts. Hydrogen would also be evolved at the same situation, and therefore the same question is open with regard to that element. Moreover, a substance of very high equivalent might be transferred, and thus produce the contraction. Upon the whole, however, the subject appears to me to demand further study; but perhaps, from all the facts of the case, we are at liberty to assume that the fleshy matter breaks up into totally new compounds, which are subsequently carried away by the blood-vessels by exosmosis.

(155). Perhaps I need hardly again record that one of the easiest experiments of electro-biology, is to determine the presence of a strong voltaic current when the muscle contracts; it is only necessary to insert one needle in the cutaneous tissues, the other in the muscular, when deflection of the galvanometer marks the result, and indicates that muscle is the negative pole of the peripheral battery.

(156). It is a current opinion amongst physiologists, that muscular contraction ensues from an intermittent current, — a point to which I have given my most anxious attention. In experimenting upon this point, all the muscles of the limb of one kind should be left, the others cut across. In this way, I believe that I have ascertained that contraction is maintained by a continuous voltaic current. The subject is surrounded by more difficulties than at first sight appear; for either the commencement or the disruption of the current gives a shock to the nervous system, which always gives an extra jerk. Besides this effect, we are not sure that the current is passing through the muscle; it may pass outside it, and only go through it at the moment of contact, or the instant before disruption, when the easiest road would be altered, and it would therefore take other courses. From a number of experiments performed upon frogs, I am of opinion that the continued current produces continuous muscular action.

(157). After having apparently discovered the true structure of muscle, it occurred to me to consider, how far an artificial muscular engine might advantageously supply the place of the steam engine. For the purposes of exciting our voltaic battery, we must apply zinc, and in my "*Sources of Physics*," I have demonstrated that the cost of zinc to that of coals, as a motive power, would be as a thousand to one. The power obtainable by zinc, through the medium of decomposition, is unlimited,— or, at least, has never been constrained; which fact might possibly enable us to use an artificial muscular machine in certain cases conveniently.

(158). The only difficulty in practice which suggests itself to my mind, is that of applying this nervous power over a short space; for it is quite clear, that the gut of animals would burst with very moderate pressure. In nature, this difficulty is overcome by using tubes of extremely minute diameter, and which, consequently, can bear the pressure without inconvenience, although occasionally even *they* are ruptured. Man cannot,

however, employ such minute structures; his mechanism is neither destined to work with contrivances very minute, as we see in the animal kingdom, nor with matter of so gigantic a size as is revealed to us in astronomical science. The only mode of overcoming this difficulty, is to use structures enormously stronger, so as to be able to take advantage of the unlimited power at our disposal. We might modify the exact application of the principle to suit our powers, and perhaps it may be convenient to obtain the increase of bulk, by solely using the zinc to evolve the hydrogen.

(159). In using the term "*enormous power,*" or any similar expression in this chapter, I simply mean a power capable of moving a heavy weight over a small space, and therefore no economy results therefrom, as the same quantity of primary change of matter ought to give rise to the same force.

(160). Many fish have the power, when they please, of giving off large quantities of electricity. Whenever this property is possessed, the creature has a peculiar organisation called the electrical battery. The battery is composed of a vast number of cells, to which a large number of nerves are distributed, which are arranged in their terminal branches so as to run at right angles to the cells. Besides the nerves, blood is distributed to each cell, which does not appear, however, to be very vascular.

(161). From the natural history of these creatures, it is quite certain, that the production of electricity is perfectly voluntary; that is, it is generated only when the creatures perceive the necessity for employing it. The generation of electricity by these creatures, is always attended with great exhaustion; hence it is shewn, that a considerable change of matter occurs during its production.

(162). An arrangement similar to that of the battery of the

electric fish, may be made in various ways. The arrangement which accords most nearly with nature, I shall term the artificial electrical fish. This artificial electrical fish is made by taking an ordinary solution of ferrocyanate of potash contained in a glass vessel. Into this glass vessel, a porous cell with a similar solution is introduced. Now, if a series of these cells be taken, and connected together by platinum wires, so arranged that the inside of the porous cell of one vessel be connected with the interior of the second by a platinum wire, no action will be indicated by the galvanometer. If, however, a current of voltaic electricity be now passed through each cell from the porous tube to the exterior, one compartment, or the hydrogen side, will become alkaline, and the salt will retain its chemical character; the other cell will become acid, and be converted into the red prussiate.

(163). In consequence of this result, the yellow prussiate is *positive* to the red prussiate, and thus a circuit is produced which I should think nearly as powerful as that observed in the bio-electric battery, when we consider the extraordinary number of cells, and their extreme narrowness.

(164). A current might be determined by acting upon a neutral fluid placed on each side a porous diaphragm, and connected together with iron or copper wires. Upon passing a voltaic circuit through this arrangement, one side will become acid, the other alkaline, and thus the electricity will be set loose whenever our artificial nerves act upon the fluid.

(165). In our artificial arrangements, the voltaic fluid acts in altering the liquid in the cells, at right angles to the course of the secondary electric fluid, which is thereby set in motion, which arrangement is perfectly similar to that observed in the real fish.

(166). Many years ago, I discovered that hydrogen might be put into a state of adhesion, and retain that state for days and weeks, and then act voltaically as a positive pole. Any arrangement by which this may be accomplished, alternately

with an oxygenated compound, will give rise to a similar phenomenon.

(167). I do not think it necessary to overburthen this part of my subject by analogous instances; but I may state generally, that any arrangement by which cells may be rendered alternately negative and positive by one voltaic circuit, may give rise to a secondary voltaic circuit, similar to that evinced by the electric fish.

BIO-PHOTO-DYNAMICS.

(168). Many creatures, as the glow-worm, have the power of becoming luminous at pleasure. Other creatures, as the luminous centipede, occasionally seen round London, give off a strong light; but in this case the phosphorescence depends upon an excretion, which, if touched, will give the same luminous appearance to the fingers. I am inclined to believe that cats and other animals have the power of generating light in their eyes by a strong effort on their part, whenever they are much alarmed, astonished, or desirous of obtaining sight of an object in a dark place. If the back part of the eye has the power of eliminating light, the light will be generated in the focus of the refracting media; and, therefore, parallel rays will emanate from the eye, and thus every ray will be thrown upon the object to be illuminated. No mode has at present occurred to me of forming an artificial glow-worm.

BIO-THERMO-DYNAMICS.

(169). Heat is constantly generated by the actions taking place in the peripheral battery. In fact, it appears that the body is warmed by changes taking place all over the body, and this changed matter is simply eliminated by the lungs

and other organs. The peripheral battery, during health, is kept in due subjection by the central; and if the two are severed in any region of the body, the actions at that part appear to run wild and uncontrolled.

(170). Sir Everard Home shewed long since, that if the nerves of a stag's antler were divided, the heat rose. When the spinal marrow is divided, the heat of those parts, from which the nervous supply is cut off, almost invariably rises to several degrees above the temperature of the inner part of the mouth. One of my former pupils, at the Aldersgate Street School of Medicine, unfortunately fractured his spine, and after a few days, the temperature at the groin amounted to as much as 100 deg. Fahrenheit, while in the mouth, or in the axilla, it only reached 96 degrees.

(171). When this additional heat is produced, the muscles rapidly waste away; and in the urine vast quantities of animal matter may be detected, shewing that great change of matter has occurred to produce this phenomenon.

(172). This phenomenon of rapid and extensive change of matter, accompanied with increased heat, observed in the peripheral battery, appears to me to be precisely similar to that observed in an ordinary voltaic battery, where the two plates are connected without any resisting medium between. In animal life, this increased temperature and waste does not commence for a few days after the division of the nerves, and it does not appear quite certain how this local action ensues.

(173). Some observers have recorded, that the heat in a limb has increased, when a main arterial trunk has been tied; a phenomenon, however, which I myself have never witnessed. When, however, we consider the importance of the supply of arterial blood for the proper action of the peripheral batteries, it will not appear singular that the interference with that supply should produce great effect.

CHAPTER SIXTH.

BIO-STATICS.

174. State of Equilibrium.—175. Sleep: Restoration of Powers: Sleep from Cold: Bodily Fatigue.—176. Waking.—177. Excitability.—178. Inactivity.—179. Proper Balance of Bodily and Mental Powers.—180. Importance of Equal Exercise of all Bodily and Mental Functions.—181. Analytic and Synthetic Modes of Instruction.—182. Undue Employment of Portions of Electric-Biological Circuit.—183. Concluding Remarks.

(174). THE sum-total of the entire apparatus of animal life is balanced, or in equilibrium, and remains quiescent till some impression acts upon the aisthenic pole from without,—upon the somaisthenic pole from within; or until some idea rises in the central battery.

(175). After the electro-biological circuit has been in action, a greater or less amount of exhaustion occurs, and a certain time is required for the complete restoration of the functions; and sleep must be regarded as a state wherein excitability is lessened, and restoration takes place. Sleep may almost invariably be produced by a sufficient amount of cold: when the amount is extreme, it causes a sleep so profound, that the subject of it passes into that sleep from which no man awakes. In this way, Napoleon's army perished in Russia; in this way, the traveller dies upon the Alpine passes. In practice, the application of cold will produce this refreshing state when all other medicaments fail or are inapplicable; and many a time I have assuaged a sufferer's pain, by applying a little cold water to the top of

the brain; and have thus obtained for him rest, when every other means have failed. Bodily exhaustion is another great cause of sleep; and I have frequently known farmers' boys, who are most cruelly over-worked, to fall asleep on the road, and receive serious accidents from the carts which it has been their duty to attend.

(176). During sleep, the body is refreshed, the whole bio-dynamic circuit becoming capable of more easy excitation; so that at last, by slight causes, the circuit may be set in action, and the party will awake. We have some voluntary power of being able to go to sleep. We perhaps lower the action of the heart, and the temperature of the body, when sleep takes place, and do not again awake until some unusual impression excites the circuit to action, or the excitability becomes so exalted, as to allow weaker impressions to have the same effect.

(177). The exaltation of the capability to receive impressions, seems capable of being increased to an almost unlimited extent. The eye, constantly kept in darkness, will have its excitability so increased, that the party would at last be enabled to see in the most feeble light; and it is not at all uncommon to find females so to exalt their excitability, as to become a burthen to themselves, from the slightest external influence producing a most painful impression.

(178). The Electro-Biological circuit, then, has its excitability augmented by repose; but this repose must be within certain limits, for any part of the circuit totally thrown into disuse, almost entirely loses its excitability, and becomes more or less powerless.

(179). From the above facts, it is evidently important that we should use all functions of the body proportionately, and rest them after exercise sufficiently. In the Electro-Biological circuit we have two great divisions, the peripheral battery and the central battery; or, in other words, the body and the brain. In these two divisions, the fundamental law shines forth conspicuously, for a well-developed body should be as much

sought after as a well-regulated mind. When the body wastes, it should be exercised to restore its functions. When the brain shews inaction, from too great bodily use, the bodily labour should be lessened; while that of the brain should be increased.

(180). What is true of the entire central and peripheral batteries, is true of their respective parts; the legs should be used as much as the arms; the eyes as much as the ears; and in fact, each individual organ should be employed to its normal extent. In the central circuit, all the various batteries should, in a similar manner, be exercised; for instance, the phreno-aisthenic battery should be exercised by the observation of external objects, and the application of general principles to each specific instance. The syndramic battery should be employed in the estimation of the causes and times of occurrences. To avoid being tedious, by again enumerating all the mental processes, I may state that the mind should be thoroughly exercised from specialities to general impressions, which will give to the individual an acuteness in that particular, and enable him to assign to every fact its due weight amongst other scientific truths. To exercise these properties, youths should be taught the facts and deductions of natural history, natural philosophy, chemistry, and all other similar sciences. This mode of education is practised principally by medical men, and entirely neglected by religious instructors.

(181). The opposite course of the mind, by which it descends from generalisations to specialities, has also to be followed. This mode of education is solely followed by theological teachers, and is much neglected by medical men. The difference in the mode of education gives to each of these classes great peculiarities; but the truly great man is doubtless that person who employs the two-fold method of receiving knowledge, and who ascends from specific instances to generalisation, and descends from universal laws to specialities, and applies them to particular cases.

(182). The observations which have been made concerning a large portion of the Electro-Biological circuit, apply also to all its subdivisions, or minor portions. It appears that one portion of the brain may be thrown into a state of rest, whilst another part is active. This probably comprises all that is true of what are termed "Mesmeric Phenomena." Some time since, I received a very curious account from Mr. Eaton of Norwich, detailing the effects produced on the brain * from the practice of five-finger exercises! The effect of this, when continued for hours together, is to exhaust the corresponding and its contiguous parts of the brain, and to cause the party to exhibit peculiar effects therefrom. The trickling of water and other monotonous sounds have the same effect in producing a peculiar drowsiness.

(183). Perfect health throughout the Electro-Biological circuit, can only be secured by a judicious use of all its separate parts, for we find that men, like ploughmen, who are kept entirely to bodily exercise, are much degraded in noemic or mental power. In like manner, we find that a great diminution of physical capability is found in those who confine themselves entirely to mental exercises.

* A mode of practice adopted by piano-forte students for increasing and equalising the power of the fingers; the fourth, or little finger, being usually feeble in proportion to the others, and the third finger being peculiarly intractable, until well broken in.

CHAPTER SEVENTH.

BIO-ELECTROLYSIS;

OR, THE CHANGES TAKING PLACE IN THE HUMAN BODY.

184. Changes taking place in the Batteries; Waste and Repair. — 185. Arterial Blood. — 186. Conditions necessary for Polarity. — 187. Formation of Polarity in the Animal Batteries. — 188. Artificial-Blood Corpuscule. — 189. Further Illustration. — 190. Changes at the Positive Pole. — 191. Hydrogen and Carbon. — 192. Difficulties attending the Use of Hydrocarbons as Positive Poles. — 193. Combination into which the Hydrogen enters. — 194, 195. Uncertainty concerning. — 196, 197. Dependence of Central or Peripheral Battery for its Action. — 198. Phosphorus in Gray Matter. — 199. Origination of Thought. 200. Waste, and Removal of Effete Matter. — 201. In the Voltaic Battery. — 202. In the Animal Economy. — 203. Remark.

(184). In taking a cursory glance at the changes taking place in the Electro-Biological circuit, we must briefly consider the alterations occurring both in the peripheral and central batteries, because it by no means follows that the same changes occur in both. Such considerations also include the important subjects of waste and repair, for we can no more obtain light without the wasting of the candle, or heat without combustion, than we can animal force without the creature taking food, and excreting effete matters.

(185). At both of the poles of either series of batteries, bright arterial blood, which is a highly oxygenated agent, is distributed; and this bright arterial blood may, for our present purpose, be considered as quasi-oxygen, or as having similar

properties. The electrolyte of both batteries is water, which, however, as serum, contains various neutral salts, which thereby render it a better conductor.

(186). It is a law of the voltaic circuit, that no polarity can occur unless there be some difference in the two poles, either in reference to their individual power of combining with oxygen, or from other circumstances, placing them in different relations; such as variation in temperature, in extent of surface, in state of surface, in fluids having a different affinity for that pole. Whenever we have any differences in any of these conditions, then we have a voltaic circuit determined from that pole which is rendered most capable of combining with oxygen.

(187). Whilst, therefore, bright arterial blood is supplied to each pole, no voltaic circuit could be produced, and some external force must disturb the balance, and cause polarity before that effect would ensue. But bright arterial blood appears to be a combination of easy decomposition; it readily yields its oxygen under circumstances favourable to that object, and in this respect is very similar to a mixture containing oxalic acid and chloride of gold, or gallic acid and nitrate of silver; and perhaps even to red prussiate of potash and per-salts of iron. If at one pole the arterial blood yields its oxygen, the balance is instantly destroyed, and the pole where the blood has become venous, must instantly take on a positive polarity, as the excess of oxygen at the opposite pole would determine a negative character in that situation.

(188). The blood, however, consists of two parts—corpuscules and serum; but the arterial quality is supposed to reside in the blood-corpuscule. The corpuscule may be regarded as a bag holding certain contents, which in the arterial state are highly oxygenated. To make an artificial corpuscule, becomes a matter of much interest. Now, if a little per-nitrate of iron be tied up in a membrane, it will serve to illustrate the voltaic properties of a blood corpuscule. For the purpose of examining

its electrical properties, two pieces of iron should be placed in a solution of salt, and no action will be manifested when they are connected with a galvanometer. The same result will be observed, if one of these bags of per-nitrate of iron be placed against each piece of iron. If, however, one of these bags, or artificial corpuscules, be removed, a powerful current is immediately determined from that pole, and the needle is instantly deflected. In trying this experiment, of course, it is of considerable importance, that the pieces of iron be of the same size, in the same state of surface, and that the artificial corpuscules be brought in contact with them to the same extent.

(189). The bag of per-nitrate of iron, very beautifully illustrates the functions of the blood corpuscule, when used in the manner detailed in the last experiment. But the most perfect mode in which the corpuscule itself can be copied, is by employing a mixture of solutions of proto-sulphate of iron and nitrate of silver, the former being in excess. By applying heat or light to such a corpuscule, more rapid decomposition would ensue, than if it were kept in darkness or cold: hence the oxyde of silver would be reduced from the corpuscule so acted upon, and, as a consequence thereof, the current would start from that point. If an excess of nitrate of silver were employed, the reverse conditions would manifest themselves. The artificial corpuscule might be made by a combination of any two substances,—the one having an *excess* of oxygen, the other having an *affinity for* oxygen.

(190). Having considered the functions of the electrolyte and blood-corpuscule, we have now to study the changes which occur at the *positive* pole. Now, chemistry indicates that large quantities of carbon and water are formed in, and exhaled from, the body; and, moreover, we observe that starch, gum, sugar, fat, taken for food, are thus eliminated, after combining with oxygen. All these substances, theoretically, ought to form the most powerful positive pole known; and although there are difficulties in obtaining their full powers, I have long

since shewn that gum, starch, and oxalic acid, are capable of giving good voltaic circuits with highly oxygenated substances, such as nitrate of silver, nitric acid, and chloride of gold.

(191). In all probability, the active agents of the positive pole, are hydrogen and carbon. The low equivalents of these elements eminently fit them for this purpose, as 1 pound of hydrogen would probably be as effective as 32 pounds of zinc; and 3 pounds of carbon would be equivalent to the same amount of metal, inasmuch as this latter element combines with two atoms of oxygen.

(192). From these facts, I have endeavoured to imitate nature in the use of hydrogen and carbon, but, up to the present time, with very limited success. The hydro-carbons are very insoluble in water, and are imperfect conductors; but perhaps some future experimenters will be more successful; and any person, who could use coke as the positive pole, in an effective manner, would probably have the pleasure of superseding steam engines, the ordinary forms of lights, and in fact, all other sources of power.

(193). So much for the *positive* pole: but, to have an efficient battery, the hydrogen should also enter into combination. Now, the red corpuscule of the blood might be used for that purpose, or the hydrogen might form more complex changes with the sarcous tissue.

(194). To form an opinion upon this matter, we must have recourse to chemical investigation; but, in referring to Liebig upon this point, I must state distinctly, that in the present state of science, I do not think that we are warranted in forming a perfectly definite conclusion upon the subject.

(195). In reference to the changes taking place between the elements of proteine, which is largely contained in muscle, starch, oxygen, and water, Liebig states,—"That is to say, that if the elements of proteine and starch, oxygen and water being also present, undergo transformation together, and mutually affect each other, we obtain, as the products of this

metamorphosis, urea, choleic acid, ammonia, and carbonic acid, and besides these, no other product whatever.

The elements of

$$\left.\begin{array}{r}\text{5 at. Proteine}\\ \text{15 at. Starch}\\ \text{12 at. Water}\\ \text{5 at. Oxygen}\end{array}\right\} = \left\{\begin{array}{l}\text{9 at. Choleic Acid}\\ \text{9 at. Urea}\\ \text{3 at. Ammonia}\\ \text{60 at. Carbonic Acid}\end{array}\right.$$

In detail:---

5 at. Proteine	-	5	$(C_{48}\ N_6\ H_{36}\ O_{14})$	$= C_{240}\ N_{30}\ H_{180}\ O_{70}$
15 at. Starch	-	15	$(C_{12}\ H_{10}\ O_{10})$	$= C_{180}\ H_{150}\ O_{150}$
12 at. Water	-	12	$(H O)$	$= H_{12}\ O_{12}$
5 at. Oxygen	-	-	- - - - - - - -	$= O_5$
			The sum is -	$= C_{420}\ N_{30}\ H_{342}\ O_{237}$

And—

9 at. Choleic Acid		9	$(C_{38}\ N\ H_{33}\ O_{11})$	$= C_{342}\ N_9\ H_{297}\ O_{99}$
9 at. Urea	-	9	$(C_2\ N_2\ H_4\ O_2)$	$= C_{18}\ N_{18}\ H_{36}\ O_{18}$
3 at. Ammonia	-	3	$(N\ H_3)$	$= N_3\ H_9$
60 at. Carbonic Acid		60	$(C\ O_2)$	$= C_{60}\ O_{120}$
			The sum is -	$= C_{420}\ N_{30}\ H_{342}\ O_{237}$

The transformation of the compounds of proteine present in the body, is effected by means of the oxygen conveyed by the arterial blood; and if the elements of starch, rendered soluble in the stomach, and thus carried to every part, enter into the newly-formed compounds, we have the chief constituents of the animal secretions and excretions: carbonic acid, the excretion of the lungs; urea and carbonate of ammonia, excreted by the kidneys; and choleic acid, secreted by the liver.

(196). All those changes which I have already described, appertain only to the peripheral battery; and, from the detail which I have already given, we may infer, that this battery is the main source of power in the electro-biological circuit.

(197). Having an active peripheral battery, the changes taking place in the central battery need only be excited by

virtue of changes occurring in the peripheral battery. In this respect, it will be similar in action to the electro-metallurgic precipitating trough, where no polarity would exist without connection with the battery.

(198). With this analogy to guide us, we find that bright arterial blood is supplied to all parts of the gray matter, or active part of the brain; and in this tissue, a large quantity of phosphorus also resides. Now, phosphorus, of all substances, is remarkable for its ready combination with oxygen, reducing silver, copper, and various other metals, from their solutions. But phosphorus is also remarkable for the facility with which it combines with hydrogen; but the exact part which it plays in the economy is not well understood. Certain it is, however, that phosphates are eliminated by much mental exercise.

(199). In treating of electro-pnemonics, I stated that there were good reasons for supposing that memory was active, and, consequently, we may assume, that after the brain has received impressions, a certain polarity arises therefrom, which gives rise to our thoughts. Upon the whole, it appears to me, that the possible changes occurring in the central batteries are more obscure than those of the peripheral.

(200). Bio-electrolysis now brings us to this proposition,—that no effect in the body can take place in its animal life, without a corresponding change of matter. This change of matter continually causes waste, and demands supply. The changed matter forms the effete material and would clog the system, and interfere with the voltaic agency, were some arrangement not made for removing them.

(201). My much-respected teacher, the late Professor Daniell, had an elegant contrivance to effect the removal of the sulphate of zinc, or effete matter, from the ordinary voltaic battery; and, since his time, patents have even been taken out for an analogous process.

(202). What chemists do imperfectly, nature effects with the

highest perfection; for, we perceive that the blood absorbs the carbonic acid as soon as formed, and carries it to the lungs, where it is exhaled. The blood also absorbs urea and carries it to the kidneys, to be there removed, whilst, in like manner, it casts off the choleic acid by the liver. If the first process be stopped but for five minutes, death ensues;—if the second, life is extinguished in three or four days; and we find that it is no less necessary to throw off the effete matters from the electro-biological circuit, than it is to re-charge the ordinary forms of batteries, and cast away the sulphate of zinc.

(203). To charge the electro-biological batteries, we must take suitable food; and to keep them in working order, we must eliminate the changed material. The food we take, is changed into blood; and electro-biology shews, that the blood is the vivifying agent, and explains how the blood of any animal may, in any sense, be said to be "*the life thereof.*"

CHAPTER EIGHTH.

ELECTRO-BIOLOGY OF CELLS;

OR, THE RELATION OF ELECTRICITY TO GROWTH, NUTRITION, AND CIRCULATION.

204. Universality of Cellular Structure — 205. Aggregation of Cells. — Varieties — 206, 207. Arrangement of Cells, Influence of External Forces upon. — 208. Plants, Indication of Polarity in. — 209. Influence of Electricity, Professor Solly's Experiments. — 210. Further Experiments. — On Potato Tuber. — On Germination of Seeds. — 211. Magnetism. — 212. Obscurity of Electrical Influences on Vegetation. — 213, 214. Effect of Intermittent Current on Animal Cells. — 215. Lymph Corpuscule. — 216. Continued Current. — 217. Question as to Effects of Muscular Contraction. — 218. Importance of Electricity as a Therapeutic Agent. — 219. Effect on Vegetable Circulation. — 220. Effect of Increased Current. — 221. Family Resemblance. — Peculiarities of Race. — 222. Propagation of Diseases. — 223. Entozoa and Parasitic Fungi. — 224. Acari observed by Cross and Weekes. — 225. Experiment on Aphides. — 226. Concluding Remark.

(204). THE researches of modern physiologists have now shewn, that all organic beings are ultimately resolvable into cells, and that the functions of growth and nutrition are performed through the medium of these organs. These cells are common to all parts of the organic kingdom; and, therefore, to study them in their pure form, we should have recourse to cases where they exist in their simplest conditions.

(205). These cells have manifestly very powerful inherent

forces, otherwise they would not so constantly assume the same form when aggregated together. Although this similarity extends to a certain point, external forces can modify its properties to a slight amount; for instance, the delicious Ribstone Pippin is a modification of the common crab; and the gardener, on the one hand, and the farmer on the other, so acts upon the subjects of his respective business, as to obtain the variety of plant and animal suited to his peculiar want.

(206). Nothing is at present known of the forces determining the arrangement of the cells; for instance, why in different plants such different forms should be assumed, or even in the same plant; why at one time these cells should take on the form of a mere stalk, at another the form of a gorgeous flower. Every gardener, however, knows that the flowering of plants is influenced by external forces; and he constantly talks of "flowering" a plant, as a circumstance as much under his control as digging, raking, or any other human operation.

(207). If we could once modify the inherent forces of the cell, we should give to it new properties. In aggregation, they would then leave their own peculiar form, and assume some other mode of organisation. We find already that the different parts of a single plant differ more from each other than similar parts in different plants. In animals, also, we observe great differences in the same species; for instance, if we compare the racer with the dray-horse, the Italian greyhound with the bull-dog, we shall observe extraordinary modifications of the law of development.

(208). In a plant, then, we have a body made up of individual parts or cells, which contain forces which determine its mode of growth. But inasmuch as the part helps to determine the organisation of the whole, so does the whole modify each particular part. In plants, one part tends towards the light, and makes shoots of yards in length, to be acted upon by that force; another part grows from the light, and seeks darkness.

Here we have a state somewhat resembling polarity; but the mechanism by which it is effected is by no means obvious.

(209). Experimental philosophy has not thrown much light upon the power of electrical force, to determine varieties of cell growth. The influence upon the entire plant is doubtful. Professor Solly tried an extensive series of experiments upon the effect of electricity upon the growth of plants. His paper upon this subject is of great value; but all his investigations have been attended with a negative result.

(210). I have tried various experiments upon this subject on different plants. Amongst the laborious investigations which I undertook upon the cause of the potato-disease, I tried the agency of electricity in all its forms. Slight currents of voltaic electricity, produced by a plate of zinc and copper, had no appreciable effect upon the plant. Plants kept under the influence of electric tension for weeks exhibited no difference, whether positively or negatively electrified. If two platinum poles be inserted into the tuber of a potato, and a strong voltaic current be directed through the part for a short period, the tissue around the poles will become disorganised. The gap, however, heals over, and the rest of the tuber grows as though it had received no injury. I have tried experiments upon the growth of mustard seed, under the influence of voltaic electricity, when I found that every seed which was placed near the positive pole had its vegetating power destroyed, although it is an extraordinary fact, that some fungi grew from the same situation. The result observed in this experiment was apparently electro-chemical, that is, it depended on matter eliminated at that situation, and was not due to the electric force alone.

(211). I have tried the effect of magnetism upon plants, but could not see that any effect was produced. Upon this point, however, I am dissatisfied with the result of my own investigation. I should like to see the subject further examined.

(212). The world some time since was startled by the

announcement that electricity materially enhanced the growth of plants. Electro-culture was to supersede every other form of culture, and manures were to be exchanged for the voltaic force. Further investigations proved these hopes to be groundless; and the influence of electricity upon plant-growth remains yet unknown. In nature, we have, during the thunder cloud, vast quantities of electricity of high tension passing; an effect which, as we cannot imitate, we are unable to employ for the purposes of experiment.

(213). With regard to the cells of animal bodies, one of the most wonderful and extraordinary results which I have observed, is the action of electricity derived from the intermittent current of the various forms of electro-magnetic machines. When a frog's foot is arranged in the field of the microscope, and the intermittent current is directed through the animal, the circulation instantly stops, as though by magic. The current in the veins, indeed, seems slightly to retrograde, though it still continues its course for a short period in the arteries; the whole effect giving the appearance of all the corpuscules having a tendency to be drawn into the capillaries.

(214). In consequence of the corpuscules being drawn into the capillaries, an engorgement of them results. When, however, the current is withdrawn, the blood moves again more rapidly than before, and is instantaneously again stopped, when the current is renewed.

(215). The action of the intermittent current is as decided upon the lymph-corpuscule, as it is upon the common corpuscules; for although, ordinarily, they run their course at a very different rate from the common corpuscules, they are stopped as suddenly by the intermittent currents. The interference with the circulation of the lymph-corpuscule in the capillaries is of more importance than that of the common corpuscule; because, crawling along the side of the vessel, and apparently in contact with it, it is manifestly less acted upon by the *vis a tergo* of the heart's action.

(216). When the continued current is employed, instead of the intermittent, the experiment is perhaps rather more difficult: yet, if the current be passed completely through the body, precisely the same result occurs. I have seen the circulation absolutely stopped from the very feeble current of a dozen pairs of plates. The difficulty in this experiment is, to be sure, that the voltaic force actually passes through the capillary.

(217). In these cases, where the circulation is stopped, it becomes a question, whether the contraction of the muscles has any share in the phenomenon; for it is an undoubted fact, that the result is more evident when muscular substance is included. This question, however, although it has an important bearing upon the theory of the phenomena, does not interfere with the fact itself. It appears to me, that the effect upon the lymph corpuscule almost settles the question of any possibility of mechanical causes.

(218). I need hardly state, that the bearing of these experiments is in the highest degree important; for it shews, that in whatever process of the body blood is necessary, there the electric force must have an influence. As it is manifest, that the circulation of the blood affects, more or less, every operation of the body, I need hardly state, that the experiment demonstrates the importance of electricity as a therapeutic agent.

(219). Having ascertained the important influence of electricity upon the circulation of animals, I was naturally anxious to ascertain the effect of the currents upon the circulation in certain vegetable tissues. To ascertain this fact, I placed a piece of the Valisneria under the microscope, and submitted it to the intermittent current, but I could not perceive any effect, although the self-same current would have stopped the circulation in animals, as suddenly as a stop-watch would have its movements prevented by putting up the stop.

(220). When, however, the continued current of about twelve cells of my battery was employed, and the circuit was completed for a few minutes, the globules circulating in the

plant were stopped as effectually as those of the blood-corpuscules. They appeared to me to leave the sides of the parts round which they revolved, and to become aggregated together in the centre. The value of these experiments, whether the effects are chemical or electrical, it is difficult to estimate, as in the one case we employ a current of intensity; in the other, of quantity. At present, we had better be satisfied with the assertion, that a feeble, continued current of electricity maintained for a few minutes, stops the circulation of the Valisneria.

The action upon the continued and intermittent currents, appeared the same upon other plants as on the Valisneria.

(221). I have before called attention to the inherent power of the cell, which renders it extremely difficult so to be acted upon by external causes, as to exhibit any decided variation in a body aggregated together. This inherent power gives to families their likeness, and causes the father to live again in his children. It retains the peculiarities of races, and gives the specific character to each individual species. Inasmuch, however, as the cell appears to be capable of being influenced by external causes each person possesses some slight individuality. Varieties occasionally arise, such as black men, white men, albinoes, six-fingered men; and in fact, men with every conceivable difference. These varieties, when produced, propagate like varieties, or like varieties in all essential points.

(222). The inherent power of the cell, renders it highly necessary for parties to contract marriage with healthy individuals. Insanity, consumption, idiotcy, and even trifling defects are propagated from parent to offspring. Every Insurance-office in the metropolis, before granting a policy, enquires into the peculiarities of the family, to ascertain the disease likely to supervene. Peculiarities of mind and body are propagated, and therefore the inherent power of the cell should always be considered before matrimonial union.

(223). It becomes now a matter for investigation, how far a totally different organic being may spring from another organic

body made up of cells. In practice, we find that animals are found in internal parts of other animals, where by no possibility they could have been carried, either in the form of an egg, or of a living creature. We find also, that from organic matter, other organic forms are continually arising, without proof of any seed or germ having been placed there. From these considerations we are led to enquire, whether external forces may so act upon the cell as to give rise to a totally different form of organisation. It still remains, however, an unsolved question whether parasitic fungi, as that found in the ringworm of man, parasitic creatures, as the *echinococcus hominis,* the tape-worms, and other bodies are produced by virtue of the cells of the human being taking on new forces, and aggregating in new directions; or whether the germs are carried there in some unknown method.

(224). The only experiments which bear upon this question, are those performed by Cross (fig. 2) and Weekes (fig. 3), who state

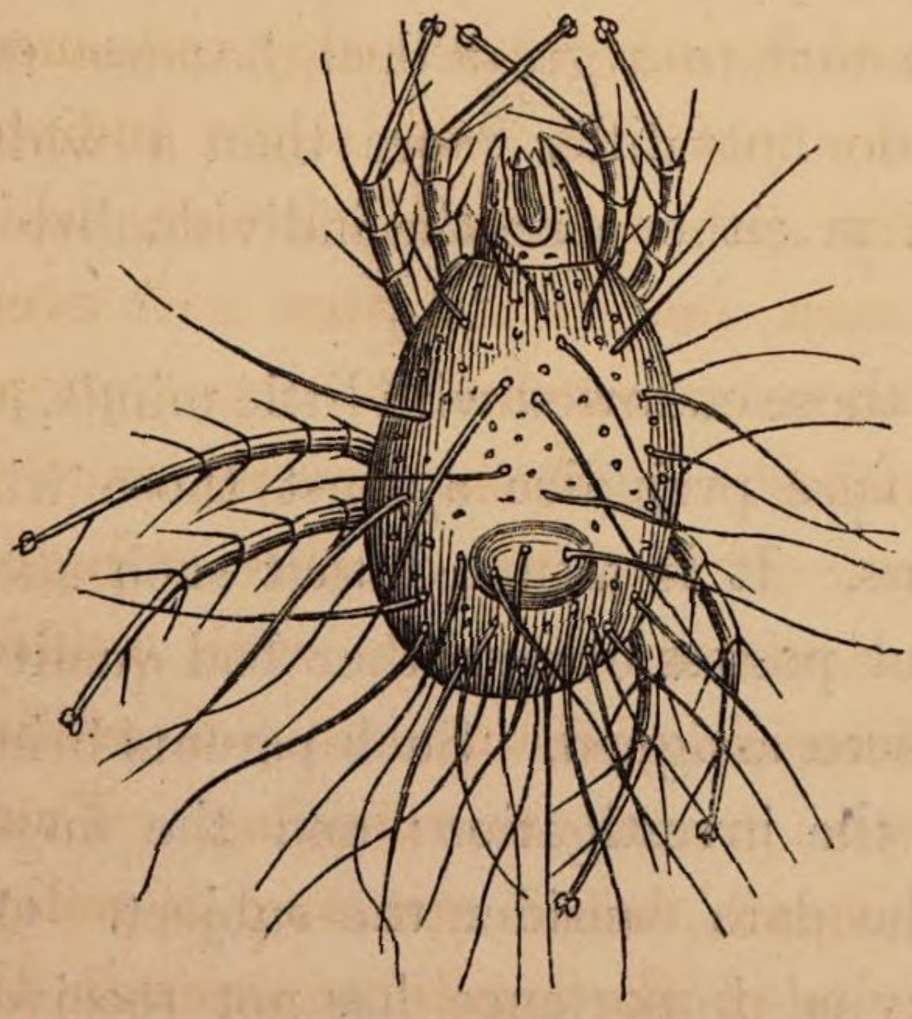


Fig. 2.

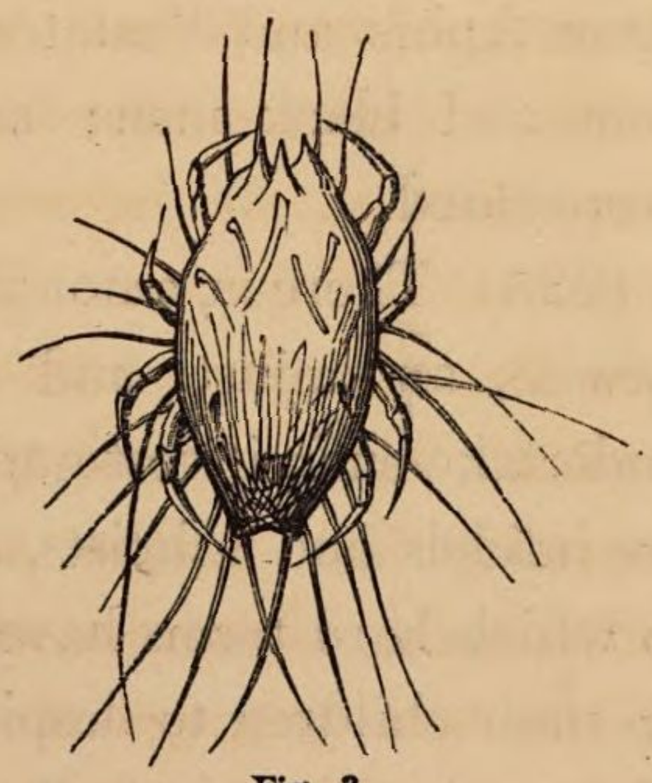


Fig. 3.

that by subjecting various solutions to the action of the voltaic force, certain acari made their appearance; the acarus found by Weekes differing from that observed by Cross. Now, I tried somewhat similar experiments to see if any creature appeared,

but have never observed anything of the kind, which could at all be traced to voltaic origin. But these experiments deserve frequent repetition by those who have the abundant funds of rich institutions at their disposal.*

(225). During last summer, I subjected the Aphis Vastator to the action of electricity of tension for a long period, and one brood was kept negatively electrified, the other positively; but after some period, when they produced young, I found on one pole the Vastator; at the opposite, the Bean Aphis. The experiment is tedious; and to me, who have no assistant, very laborious. It has not therefore been repeated over and over again to demonstrate its accuracy and universality; and therefore I can only mention it as a faint suspicion, that possibly the character of the kinds was modified by the electricity. I was induced to try the experiment, because the two kinds in nature appeared to be in some degree vicarious of each other; and changes in their relative number occur after electrical disturbances in the atmosphere. If the experiment were confirmed, it would not amount to a great deal, because the Bean Aphis and Vastator do not differ more than a white man and black man; and in either case the individuality is propagated.

(226). There is, amongst those endowed with little minds, an unwise, an unjust, and a false prejudice against those who undertake such investigations. It is assumed that such men are infidels and atheists, and possess every other bad quality, to which hard terms have been assigned. Such parents bring up their children to despise the investigation; and the finger of scorn is pointed at all who dare consider the subject. On this account, this matter of vital importance has not received the labour and talent it merits. It has already been proved by Schwann and Schneider, that a cell is the basis of all organic bodies. And if hereafter it shall be discerned, that from modifi-

* I have just received a letter from Mr. Weekes, stating that he has lately observed two more species of acari produced from other solutions.

cations in the inherent power of the cell, different organic bodies result, what a sublime view would it present to the human mind! And the fact might justly be held by some future Paley, yet unborn, as the most powerful proof deducible from nature of the infinite power and wisdom of God.

CHAPTER NINTH.

ELECTRO-BIOLOGY OF THE SPINAL CHORD AND SYMPATHETIC SYSTEM.

227. Involuntary Actions.—228. Spinal Chord.—229. Great difficulty of arriving at satisfactory conclusions by Experiment.—230. Great Sympathetic.—231. Ganglions in Connection with.—232. Imperfect Functions of, with Relation to Noemic Batteries.—233. Remark.—234. Voltaic Imitation.—235. Strong Mental Impressions.—236. Action of Parts which are supplied from the Sympathetic System.

(227). In the entire arrangement of the body, there is reason to believe that a certain combination of aisthenic impressions gives rise involuntarily, that is to say, independently of the noemic battery and without any mental effort, to certain results.

(228). The mechanism by which these phenomena are produced might, with some shew of justice, perhaps, be sought in the gray matter of the spinal chord. This structure is evidently vascular, like the gray matter of the brain; and although difficult to inject, I possess most beautiful preparations which I have made with the carmine injection before described, and in which the minutest ramifications of the capillaries are filled.

(229). In conducting experiments upon such movements in the lower animals, where the brain is removed by decapitation, or but a segment of the spinal chord is left, great difficulties occur in the consideration of all the phenomena observed; for, we must remember that we have the peripheral battery left

entire in all its parts; and though the connections of the wires may be severed, yet it is possible that the circuit may be completed by some other path, and thus interfere with any theories supposing the spinal chord to give origin to the movements. Under such circumstances, it appears to me that every experiment should be carefully weighed in the mind, and studied in reference to ordinary voltaic laws, before we pass an opinion as to whether any involuntary current comes from the organisation of the peripheral battery alone, or whether it is due to specific arrangements in the spinal chord. There is no evidence of any memory existing in any part of the apparatus. This subject deserves much labour from the hands of the electro-biologist.

(230). We now, however, come to speak of a very peculiar nervous mechanism, termed the great sympathetic nerve, which supplies a large amount of the internal organs of the body. Now, in all the parts to which this nerve is distributed, we have but a feeble knowledge of the changes going on. This knowledge is extremely imperfect, or, I may say, that an unit of sensation is only derived from a large extent of body. From these facts, it is apparent that the multitude of nervous fibres distributed to the alimentary canal, to the heart, and other viscera, do not carry separate impressions to the brain.

(231). The anatomy of this nerve corresponds with its physiology, for the fibres are traced to certain ganglia, which possess a structure somewhat similar to the gray matter of the brain. From these ganglia, however, other fibres travelling to the spinal chord exist, indicating the means by which our impressions are carried to that organ.

(232). From the above facts, we are in a position to assert that the ganglia of the sympathetic nerves are rudimentary brains, which might be evolved in structure to such an extent, as to render us cognisant of minute changes taking place in our own bodies, but which, for many hundred filaments, only send a single impression to the noemic batteries in the skull.

As a consequence of this we know that the heart is beating, but we cannot distinguish all the minute parts of each beat, as we can the minute movements of the fingers, or other parts of the body. We may know that we have a pain in our stomach, but we can never refer it to its exact locality with the same exactness of localisation which attaches to impressions received in situations where the units of sensation are more frequently distributed.

(233). It will not be difficult to conceive a being who shall be cognisant of every single change taking place in his body; but whilst, in this respect, we must admit our imperfect organisation, yet we have reason to rejoice at the goodness of Providence in having withheld that knowledge from us. How miserable would be the being who saw mentally every step in the growth of tubercles in the lungs, or other fatal disease; and to what danger should we be exposed, if the assimilation of our food, or the action of our hearts, were regulated by our own volition.

(234). A mechanism, by which a multitude of fibres may transmit a single impression to the brain, may be readily imitated by voltaic electricity, by placing a dozen or more wires in a battery cell as one pole, and by opposing a single wire to the whole. By this arrangement, an impression transmitted down the one wire would affect the twenty, or any one of the twenty, the one opposed wire.

(235). It is manifest, that from a structure like this, a mental impression might produce the most powerful results; and, in practice, we constantly find that the heart's action is interfered with, or even altogether stopped, by a strong mental emotion. In like manner, the entire process of digestion and assimilation may be instantly stopped by sudden joy, grief, or other powerful action of the mind.

(236). The parts supplied by the sympathetic system are principally excited to action, not so much by the direct influence of voltaic power emanating from the brain, as from a

direct stimulus supplied to themselves; and perhaps partake of the action of a closed voltaic circuit excited to action by a supply of arterial fluid. The heart acts when blood, i.e. good arterial blood, is supplied to its fibres; but if hot water or black blood are in contact with the muscular fibres, the action is immediately stopped.

CHAPTER TENTH.

ELECTRO-THERAPEUTICS.

237. Electro-Therapeutics; Preliminary Remarks, — 238, 239, 240. Frictional Electricity; Apparatus for. — 241. State of Tension in the Human Body. — 242. As a Therapeutic Agent. — 243. Aura. — 244. Sparks. — 245. From Cats. — 246. Leyden Jar; Shock, as a remedial Agent. — 247. Leyden Battery. — 248. Electrometers. — 249. Lightning; its discharge through the Human Body. — 250, 251. Various effects of. — 252. Electric Eel and Torpedo. — 253. Hydro-Electric Machine. — 254. Thermo-Electricity. — 255. Voltaic Electricity. — 256. Voltaic Electricity; its quantity; easy Bodily Application. — 257. Galvanic Rings and Bracelets. — 258. Cruikshank's Battery. — 259. Voltaic Pile. — 260. Couronne de Tasse. — 261. Electro-Therapeutic Battery. — 262. Sulphate of Copper; Platinised Silver, and Nitric-Acid Batteries. — 263. Water Battery. — 264. Remark. — 265. Action of Voltaic Electricity on the Body; Theory. — 266. Its application in Tic-douloureux. — 267. Voltaic Blistering; Anecdote. — 268, 269. Action of Muscle. — 270. Disorders dependent on the Circulation. — 271. Remark. — 272. Electro-Magnetic Apparatus; General Remarks; Quantity and Intensity. — 273. Theory of Action. — 274. Primary Coil Machine. — 275. Secondary Coil Machine. — 276. Modification of. — 277. Various ways of Completing and Breaking the Circuit. — 278. Necessity for Uniform Current. — 279. Instrument for obtaining. — 280. Electro-Galvanic Machine. — 281. Remark. — 282. Regulation of Power; various means. — 283. Action on the Body. — 284. Magneto-Electric Apparatus. — 285. Broken and Continuous Current from. — 286. Observation on. — 287. Advantages of. — 288. Adjustment of Power. — 289. Magnetism applied to Animal Bodies. — 290. Analogy. — 291. Result of Experiments. — 292. Statements by Laennec; Remarks on. — 293. Electric Evolution of Heat. — 294. Intense Heat. — 295. Electric Cautery; Remarks on. — 296, 297. Various Cases and Modes of Application. — 298. Observation. 299. The Electric Light; Remarks on. — 300, 301. Voltaic Electricity; its Decomposing Power as a Medical Agent. — 302. Effects produced at Positive Pole. — 303. Suggestion. — 304. Thermo-Electro-Therapeutics; Remark. —

305. Influence of Temperature on Voltaic Action. — 306. On the Human Frame. — 307. On Vegetable, or Cell Life. — 308. On the Human Batteries; on Bodily Pain. — 309. Light; its Effects on the Body. — 310. Absence of Light. — 311. Central Batteries; Moral Effects. — 312. Employment of, by the Practitioner. — 313. Pharmaco-Electro-Therapeutics. — 314. Food; Transfusion of Blood. — 315. Drinking of Water. — 316. Effects of Wind. — 317. Friction of the Surface. — Various Forces influencing the Electro-Biological Circuit.

(237). HAVING found that complicated electrical changes take place in the human frame, we may necessarily expect that electricity should be an important remedial agent. In using electricity we must remember its two-fold character; firstly, its intensity, secondly, its quantity, and use the one or the other according to circumstances. We have, moreover, to consider the various forces which may be produced by electricity, so far as they may be used as therapeutic agents; and lastly, we have briefly to study agents and forces from other sources, which may influence the voltaic current in the human body.

FRICTIONAL ELECTRICITY.

(238). By frictional electricity, we obtain great intensity with but very feeble quantity. It is produced by the friction of any non-conducting substance; as, for instance, by rubbing sealing-wax or a glass-rod with a silk handkerchief. Practically, either a cylindrical machine (fig. 4), or

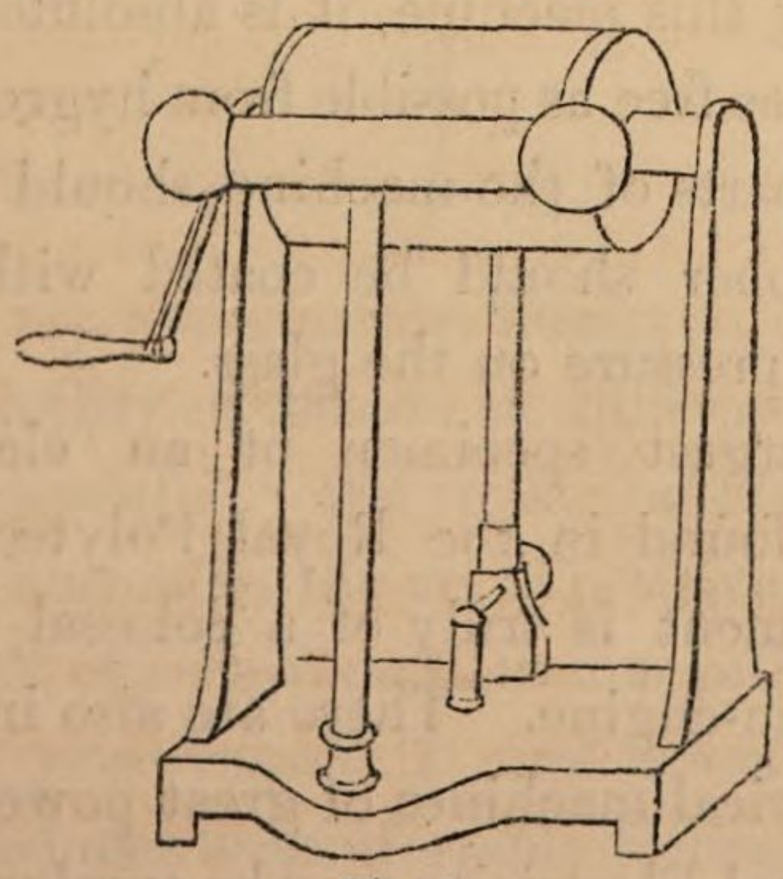


Fig. 4.

a plate machine (fig. 5) are employed. In both cases, the

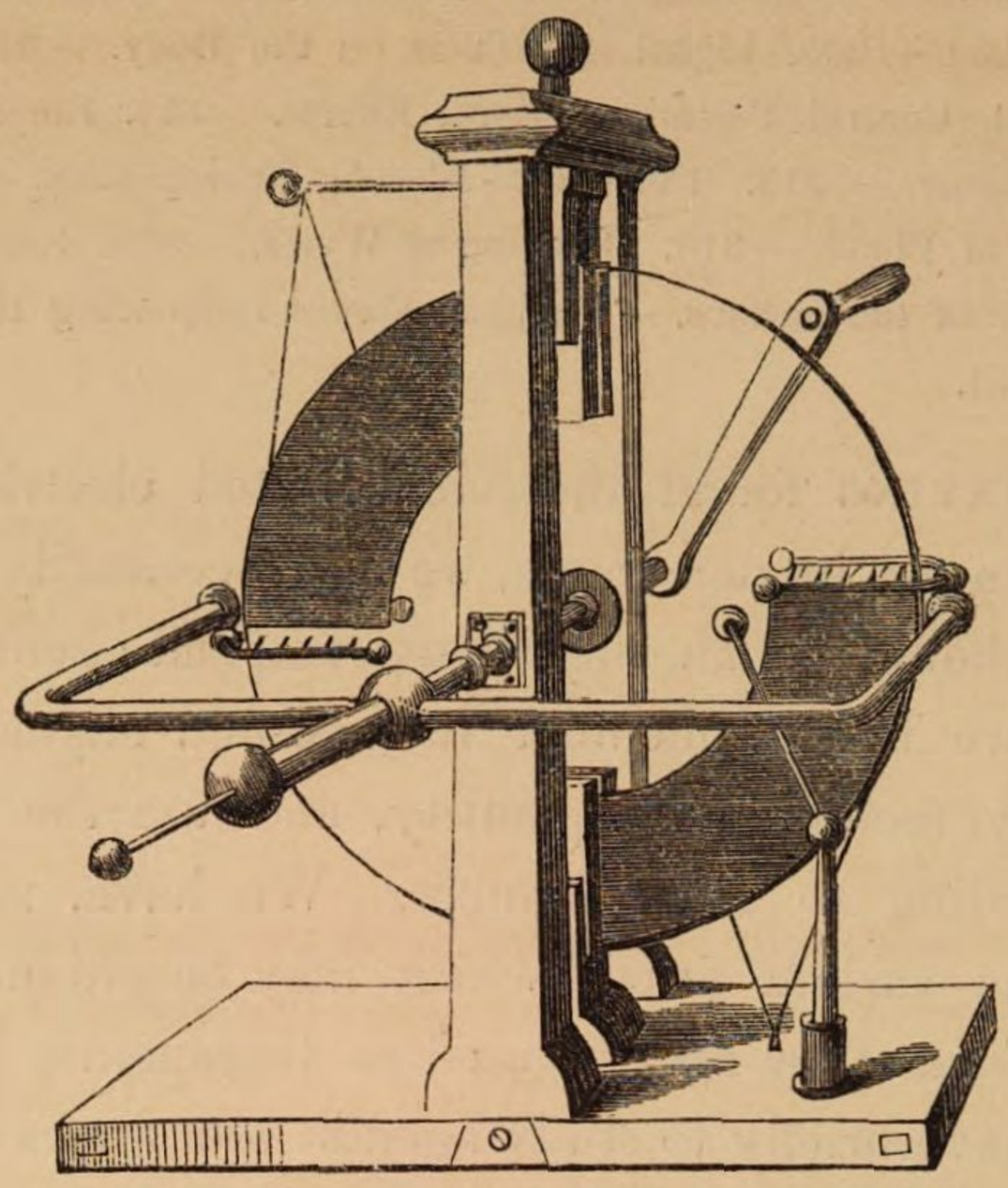


Fig. 5.

electricity is evolved from the surface of the glass rubbing upon the rubber or cushion. The glass becomes positive; the rubber becomes negative. To maintain a constant supply of electricity, either the rubber or the prime conductor must be connected with the earth, which is best effected by a chain passing to the gas-pipes or water-pipes. When we desire positive electricity, the chain must be connected with the rubber; when negative, with the conductor.

(239). In using this machine, it is absolutely necessary that the air should be as free as possible from hygrometric moisture; and that all the parts of the machine should be kept dry and warm. The rubber should be coated with amalgam, and should exert due pressure on the glass.

(240). The largest specimen of an electrical machine, perhaps, is to be found in the Royal Polytechnic Institution, where the instrument is truly of a colossal character, and is worked by a steam-engine. There are also in the Royal Institution some electrical machines of great power.

(241). Frictional Electricity may be employed, first, to throw

the human body into a state of tension, either negative or positive. To effect this, the person should be placed on a stool with glass legs (fig. 6); or, if in a bed, by placing the feet of the

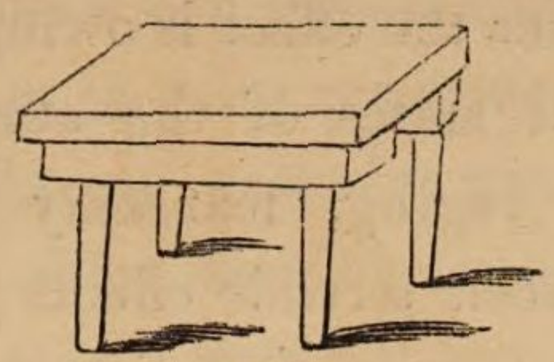


Fig. 6.

bedstead on blocks of glass. Having thus arranged the patient, he may be negatively electrified by connecting his body by a metallic wire to the rubber of the machine; and positively, with the prime conductor. In a room where an electrical machine is in action, every single object is negatively electrified if the rubber be connected with the room; and positively, if the conductor be connected with the room by a chain, or other conducting material. When a party is under very strong electrical tension, the hairs of his head will diverge like the accompanying representation (fig. 7).

Fig. 7.

(242). From my experiments, however, both upon animals and plants, the utility of tension as a therapeutic agent is very slight, or even doubtful. We are almost always under more or less tension, as, normally, the air is positive, and the surface of the earth, with all objects upon it, in a negative state. Perhaps, as a matter of observation, I may assert that the absence of electricity produces uncomfortable feelings in many persons;

and perhaps an excess is also unpleasant. We find that nervous females constantly suffer before a thunder-storm; and hysterical females shew marks of hysteria. In these cases, however, it is difficult to tell whether the effect is owing to the electricity, or to other concomitant states of the atmosphere. When the storm is absolutely raging, fear may be the cause of the result; and I have seen terrible effects produced by the great alarm which a thunder storm excites in the minds of some individuals.

(243). When a human being is in a state of high tension, and any pointed conducting body is brought near to him, the electricity is drawn off very gently from all the surrounding parts, giving rise to the phenomenon, called "The Aura." The Aura would only perhaps act as a mild stimulus to the aisthenic pole of the peripheral battery. It might perhaps be advantageously used to very delicate organs, like the eye or ear.

(244). We may next employ frictional electricity to draw sparks from the body, which amounts, in fact, to the passage of feeble electricity through the part. To effect this object, the body should be arranged in the same way as when we desire to throw it into a state of tension. When a high state of tension is procured, sparks will emanate freely from any part of the body to which any conducting body is approximated. The utility of sparks is considerable, where a stimulus is desired to any part of the body. It may be employed with advantage, when any of the aisthenic batteries act but feebly. Whether there be a deficiency in the power of vision, of feeling, of tasting, and perhaps even of motion, in superficial muscles, it may be usefully employed when the medical practitioner believes a stimulus is desirable. Where a stimulns is considered likely to be injurious, electric sparks should not be used. By the use of electric sparks we may make the skin red, indicating that it has effect upon the capillary vessels

(245). The effect of sparks may be readily tried upon cats, as their own skins constitute an electrical machine, and may be excited by means of a dry silk handkerchief, especially in

dry frosty weather, and after the cat has been warming herself before the fire. By stroking the fur in the wrong direction, a copious supply of sparks will emanate therefrom, and poor pussy will generally shew her discomfiture, by mewing most bitterly if the operation be long continued. Some persons in brushing their hair during easterly winds will give rise to electricity, which will shew itself by the evolution of sparks.

(246). Sparks consist of a very minute quantity of electricity at a high tension. We may increase the quantity by a contrivance called a Leyden jar (figs. 8, 9). By this instrument

Fig. 8.

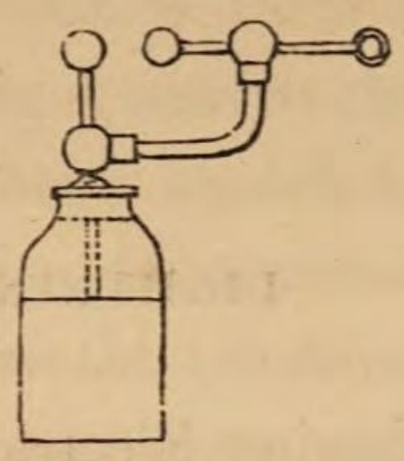


Fig. 9.

the electricity is accumulated, and produces far more powerful results when acting upon the system, as it gives rise to the sensation of a shock. Druitt mentions a case of dislocation of a finger by the shock from a Leyden jar. The shock of the Leyden jar has been thought by some persons likely to be serviceable in supposed death from lightning, and curious cases have been related, wherein after an animal has been stunned by electricity, it has been revived by a shock transmitted in the opposite direction.

(247). When any number of Leyden jars are associated together, the arrangement is called a Leyden battery (fig. 10);

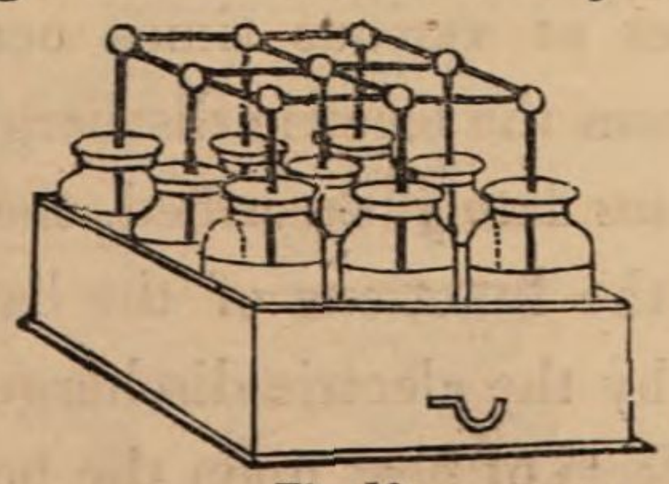


Fig. 10.

and the force may be accumulated to such an cxtent as to be capable of killing small animals; but neither the Leyden jar nor battery are at present employed for therapeutic purposes.

(248). The power of charges contained in Leyden jars and batteries, may be ascertained and regulated by Lane's discharging electrometer (fig. 9), which estimates the power by measuring the distance in air which the discharge is capable of traversing. Relative strengths of electrical charges may also be learned by Henley's quadrant electrometer (fig. 11).

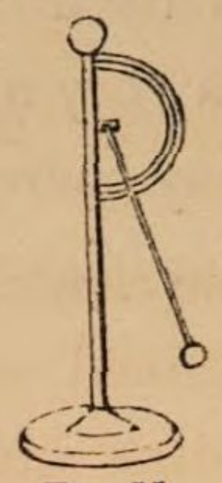


Fig. 11.

LIGHTNING ELECTRICITY.

(249). Lightning Electricity is a force of electricity eliminated during the formation of the thunder-cloud; and it is distinguished both for its vast quantity and for its enormous intensity. When the discharge occurs through the human body, it may in certain cases instantly destroy life. When it thus acts, it may exhaust at once the electro-biological circuit, and annihilate life. Sometimes all the parts of the entire electro-biological circuit are not destroyed, but portions are alone affected. In some of these cases the symptoms of apoplexy present themselves, such as blindness, deafness, or a greater or less amount of paralysis. If we turn to the published statements of these injuries, we shall at once perceive that every possible injury does at various times occur to the electro-biological circuit from the electric discharge.

(250). In the cases lately described, the effects are due to the impairment of the functions of the batteries from the exhaustion produced by the electric discharge. Lightning may also produce the effects of heat upon the body, and give rise to blisters, burns, and other discolorations. When heat is generated, it may act upon surrounding objects; hence watches and coins have frequently been melted at the same time.

(251). Besides the effect of heat, lightning has the effect of disintegrating or tearing asunder the parts of organic bodies. This is constantly seen when trees are struck by lightning, as the limbs are torn from the trunk, and the bark stripped off. Sometimes, in human beings, the flesh is torn, and extensive lacerations may occur from the effects of lightning.

ANIMAL ELECTRICITY.

(252). The discharge of the electric eel and torpedo, from its quantity and intensity combined, enables these creatures instantly to kill their prey by directing a current through them; and the stoutest lifeguardsman has been known to faint when he has been acted upon by the shock. Of course, we can conceive it possible to employ this power, though from the scarcity of the creature, it has not, and perhaps never will be, used as a therapeutic agent. Animal electricity would be, in its effects, intermediate between frictional and lightning electricity.

HYDRO-ELECTRICITY.

(253). A very powerful electric current can be produced by high-pressure steam, by means of a peculiar apparatus called a hydro-electric machine. In this machine, the friction of the

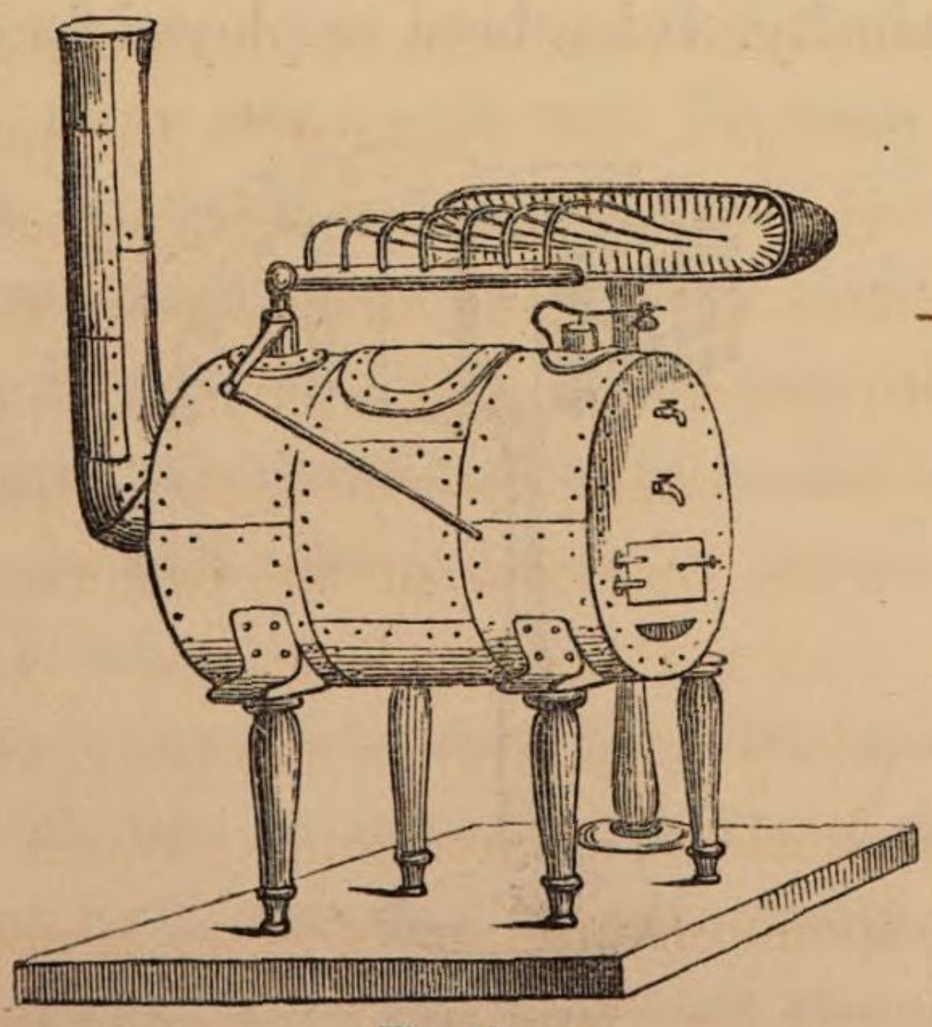


Fig. 12.

steam against wood gives rise to the electric force. The hydro-electric machine gives rise to a larger quantity of electricity at high tension than ordinary frictional machines. An objection to its use would be its cost in the first instance, and the trouble of making it; and I must confess, that working with high-pressure boilers creates an unpleasant idea, which, after all, is not unlike sitting upon a barrel of gunpowder. If it should hereafter be proved, that electricity is beneficial to the growth of plants, this form of apparatus will probably be preferable to all others. For electro-therapeutics, it is only calculated for hospitals, or those who make a business of it; and, at any rate, at present, does not appear to be likely to be employed. If, however, any state of a patient is hereafter shewn to be benefited by electric tension, this instrument might be used to keep a ward of any size, and all the persons in it, under that particular state.

THERMO-ELECTRICITY.

(254). A very feeble current of electricity is set in motion when alternate bars of various metals, but particularly of bismuth and antimony, are soldered together (fig. 13). The electricity thus evolved, possesses but little of the property of quantity, and even less of intensity. It has been employed for determining the

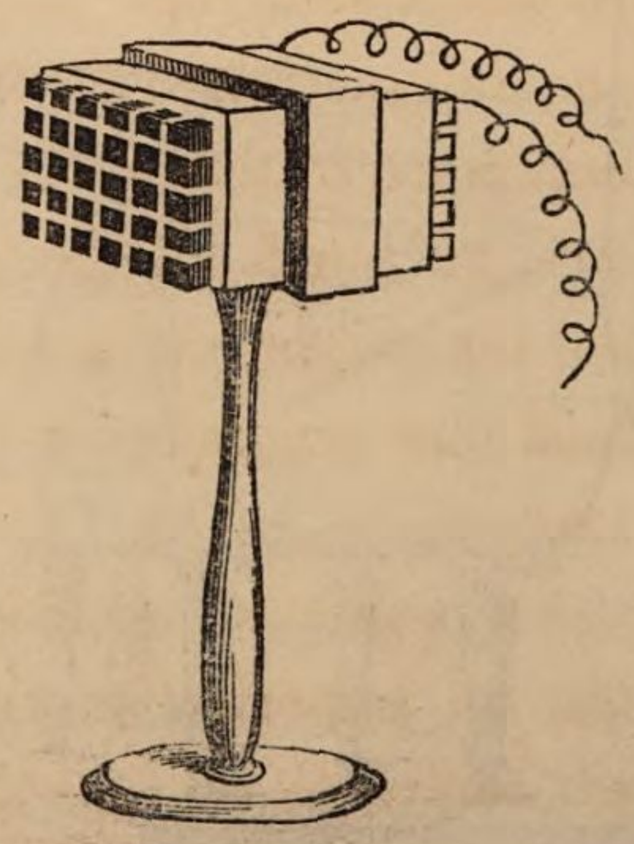


Fig. 13.

temperature of various tissues of the body; although, up to the present time, no use for it has been found in eleetro-therapeutics.

(255). Voltaic electricity is that form of electricity which is set in motion in a voltaic battery, and is remarkable for the enormous quantity of electricity evolved, with but little power to overcome obstacles. We cannot, however, take advantage of the enormous amount of electricity which is set in motion by large batteries; in fact, if we could only force the electricity, capable of being evolved from a single square inch of negative metal, we should instantly cause the destruction of an animal.

(256). We may cause voltaic electricity to act upon the body in a very simple manner; for instance, by simply inclosing a portion of the body between two dissimilar metals, a current is generated; thus, if a piece of zinc be placed on the under surface of the tongue, and a piece of copper or silver at the upper, a circuit is formed, and we know that voltaic action has occurred, from the organ of taste being stimulated, and a peculiar sensation produced.

(257). Such a mode of excitation will answer for the mucous membranes, which are constantly moist. It would also answer for the skins of frogs, but our skins do not seem to be favourable for the transmission of such impressions, and consequently galvanic rings, galvanic bracelets, and all other similar electro-therapeutic curiosities, may be supposed to be quite inert. Some years ago, there was a vast rage for such contrivances; so much so, that, for a time, it was difficult to supply the demand. Of course, abundance of testimony could be produced, of their efficacy; in fact, as much as for any other quackery; but, from an impartial investigation as to their merits, there appeared to be no sufficient grounds for supposing that they possessed any influence.

(258). In acting upon animals, we have generally to influence bodies with but an imperfect power of conduction; so that we require a high series, or great intensity, although but a small amount of electricity passes at each moment. The form

of battery which has heretofore been chiefly employed by the electro-therapeutist, is a many-celled, or Cruikshank's battery, which consists of alternate layers of copper and zinc, with a layer of fluid between each pair. A battery of this kind, consisting of fifty cells, forms a very effective instrument for the electro-therapeutist (fig. 13).

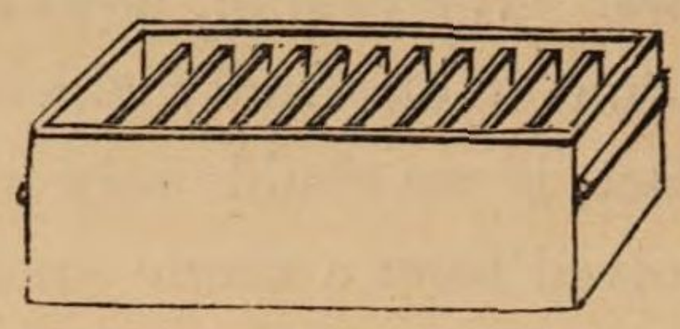


Fig. 14.

(259). A voltaic pile consisting of from twelve to fifty pairs of zinc and copper plates soldered together, and charged by inserting a piece of lint moistened with salt and water, will also form an effective electro-therapeutic battery.

(260). The Couronne de Tasse, made of zinc and copper wires, or better still, of zinc and silver wires, in a series of about fifty, forms a very valuable electro-therapeutic battery.

(261). The standard battery, which I prefer for electro-therapeutics, is made by using small glass vessels, with a thin partition of porous earthenware, to prevent the contact of the positive and negative metals of the arrangement. For the battery itself, pieces of zinc about the eighth of an inch in thickness, and an inch and a half long, and half an inch wide, are employed; these should be thoroughly amalgamated with mercury, to stop local action; and when prepared, they should fit into a binding screw, to which a narrow slip of platinised silver is soldered; and the whole should be arranged in series like the Couronne de Tasse. This battery is charged with water, to which one eighth of sulphuric-acid has been added, and if the whole is properly arranged, will last in action two, three, or four weeks without any alteration. I have recommended that they should be kept in series of a dozen, so that about four batteries would be required for an effective instrument. This instrument is sold by Messrs. Horne and Thornthwaite, under the term of the "Electro-Therapeutic Battery."

(262). The sulphate of copper batteries, the nitric-acid batteries, or the platinised silver batteries, on a large scale, are hardly applicable for the Electro-Therapeutist, as he requires a high series to drive even a small amount of electricity through the body.

(263). By the water battery of large series, we obtain high tension with but very feeble quantity. It is a form of battery not generally used for medical purposes.

(264). Before describing the effects of voltaic electricity on the body, I may mention that in a subsequent part of this chapter, I shall have to speak of certain secondary results which come from voltaic action, such as the effects of heat, light, and decomposition, which may arise therefrom; but at present I will confine my attention to the results obtainable by voltaic electricity.

(265). When voltaic electricity acts upon the body, the aisthenic pole is excited. In the skin, the ordinary sensation of feeling is produced, which, if long continued, will increase to positive pain; at the eye, we obtain a flash of light; at the tongue, the sensation of taste. The theory of this action is doubtless the excitation of the voltaic batteries in the body, upon the principle of electricity determining polarity, and consequently setting in motion voltaic force, where the elements of a voltaic battery exist.

(266). Great care is required in the use of voltaic electricity, because it may exhaust the nervous power of the parts on which it acts, and thus may effect great mischief. In certain cases, I think it might be employed for the purpose of destroying sensation in cases of extreme pain, such as that of tic-douloureux, painful stumps, etc. In these instances, a decidedly powerful current should be passed through the part, and the amount of electricity may be estimated by the amount of hydrogen visibly evolved from the platinised silver in the voltaic battery; for if a very feeble current passes, but very little gas is evolved; if a stronger one, a greater quantity of hydrogen passes off.

(267). Without care, the skin is apt to be blistered by the voltaic force; and I lately heard an amusing statement of a gentleman who purchased a Cruikshank's battery, with which, having clumsily blistered himself, he desired to return the instrument to the maker, because, as he stated, the instrument generated electricity of a peculiarly acrid nature. When we desire to prevent blistering, the poles coming in contact with the body should be kept continually in motion.

(268). The sarco-dynamic pole of the peripheral battery, or muscular substance, is excited by the voltaic force. I have already mentioned, when treating on Sarco-Dynamics, that although a jump of the limb occurred when the current was either completed or interrupted, yet I found by careful experiments, that muscles are kept in a state of contraction by a continuous current.

(269). If, however, too great a current acts through the muscles, such exhaustion takes place that contraction will not again for some time ensue; and a question arises, whether it may not be turned to good account for the alleviation of tonic spasms, which I shall hereafter have to consider more minutely.

(270). The voltaic force also interferes with the circulation of the blood; hence, all changes in the body depending upon the circulation may be influenced by voltaic electricity.

(271). In applying voltaic force, we may conveniently employ poles covered with lint or sponge dipped in salt and water. The salt renders the water a good conductor; and the water comes into immediate contact with the skin.

COIL AND ELECTRO-MAGNETIC ELECTRICITY.

(272). We have under this head to consider forms of apparatus which are important, inasmuch as they are most frequently employed by the electro-therapeutist, and constitute

the ordinary medical machines. These machines, however, are constructed in many different ways, and on that account require a somewhat particular description. They possess, nevertheless, in all cases, the same property, namely that of obtaining an intermittent current of intensity from a primary current of quantity. According to the primary laws of physics, we can only derive force from some prior change of matter, which change ultimately resolves itself into some new attraction. If we have a certain amount of action in a single voltaic battery, it gives us the effect of quantity; when the action takes place in a series, it gives us the effect of intensity.

(273). By all the forms of medical machines, we obtain a current of intensity from a single voltaic battery; and thus we find that they are far more convenient to manage than a battery of high series. This result is obtained by a power of electricity, when passing through a wire, to develop a second current in a contiguous wire parallel to the first, and insulated from it. The second current is generated whenever the battery is either made or broken, but the direction of the current in the two instances is opposite.

(274). The simplest machine in which this phenomenon is manifested, is made by simply winding a stout covered copper wire of several yards in length into a coil, leaving the two ends to be connected with the two poles of a voltaic battery. If into the interior of the primary wire a piece of soft iron is inserted, so that it is magnetised by the voltaic power, the effects are greatly heightened, as we then add the force derived from magnetic induction to that produced by the simple induction through the wires. This machine is called the Primary Coil Machine.

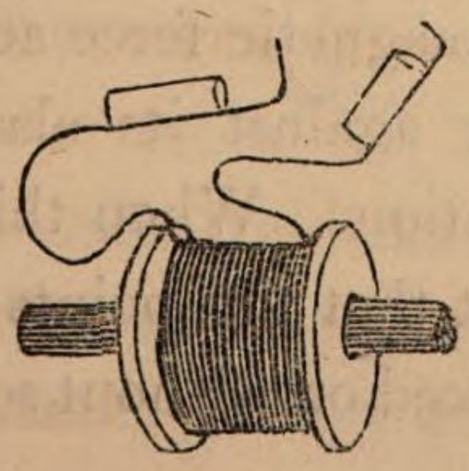


Fig. 15.

(275). The Secondary Coil machine is made by winding a second fine covered wire, of some hundred feet in length, in the same direction over the primary wire described in the last section, and leaving the two ends free to be attached to any object. Whenever the circuit is completed through the first wire, a current of strong tension is produced in the secondary. This current is in the same direction when the circuit is made, in the contrary direction when the circuit is broken. In this way we have by a rapid succession of the completion and rupture of the primary circuit, a rapid succession of currents in the secondary wire of a to-and-fro character.

(276). A modification in the construction of the medical machines may be made, by connecting one end of the secondary wire to one end of the primary wire, and then taking the shock from the extreme end of both wires combined. By this arrangement, the battery power has but a small length of thick wire to traverse, whilst the induced current is strengthened from its being also derived from the primary wire placed in close contact with the magnet.

(277). In using any of these machines, contrivances must be adopted for rapidly making and breaking the circuit, which is sometimes accomplished by mechanical means, as by the aid of a multiplying wheel, worked either by the hand or by clock-work. At other times, the same result is obtained by electro-magnetic means, as when a small electro-magnet is made rapidly to revolve between the poles of a permanent magnet. Perhaps, however, the most elegant mode to accomplish this object consists in using a piece of soft iron attached to a watch-spring, which vibrates with great rapidity under the action of the voltaic current, from the magnetic force acting upon the soft iron attached to the spring against its elasticity, and causing a rapid continuous vibration. When this latter contrivance is adopted, it is important that the points of contact should consist of solid platinum, fixed on without solder; for when solder is

used, the tin unites with the platinum, becomes oxydised, and rapidly ceases to act.

(278). For electro-therapeutics, or even for all purposes, it is advisable that the current should act in one uniform direction, and that it should not be a to-and-fro current, as ordinarily produced. Whenever an instrument is bought, this fact should be ascertained, which may be readily effected by finding whether metals are reduced from solutions of their salts, on only one of the platinum poles attached to the terminations of the wires.

(279). This unity of direction in a secondary coil machine, may be obtained by using contrivances to cut off one of the currents of the secondary wire. I have a machine of this character (fig. 16), constructed many years ago for me, in which it is so arranged, that when the first circuit is broken, the second is in continuity; when the first circuit is completed, the second is broken. This instrument forms an extremely valuable chemical and therapeutic agent. It has, however, the disadvantage of requiring manual or mechanical labour to cause the revolution of the wheel.

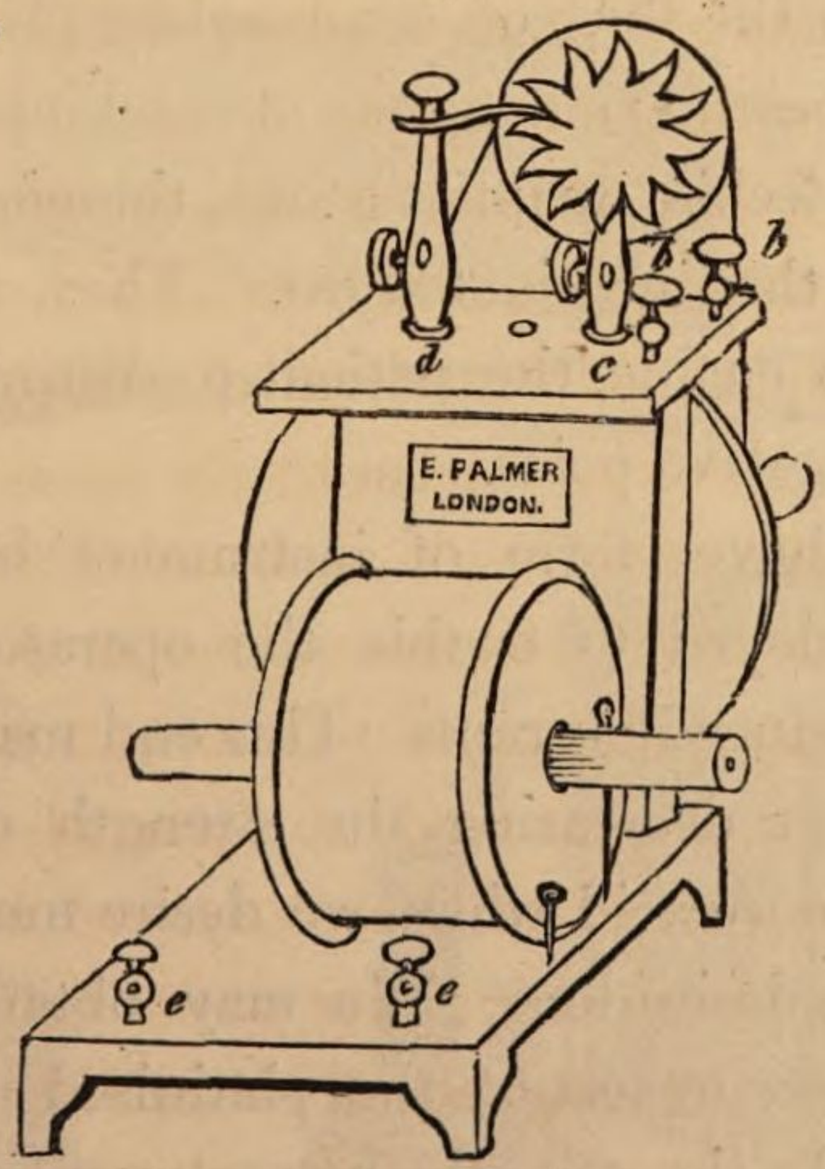


Fig. 16.

(280). Messrs. Horne and Thornthwaite have contrived a medical machine, which gives a single current upon the self-acting or watch-spring break. They employ a coil, in which

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the primary and secondary wires are connected together, but have so arranged the terminations of the wires, that one of the currents in the secondary circuit is prevented from acting. They call their machine "The Electro-Galvanic Machine" (fig. 17),

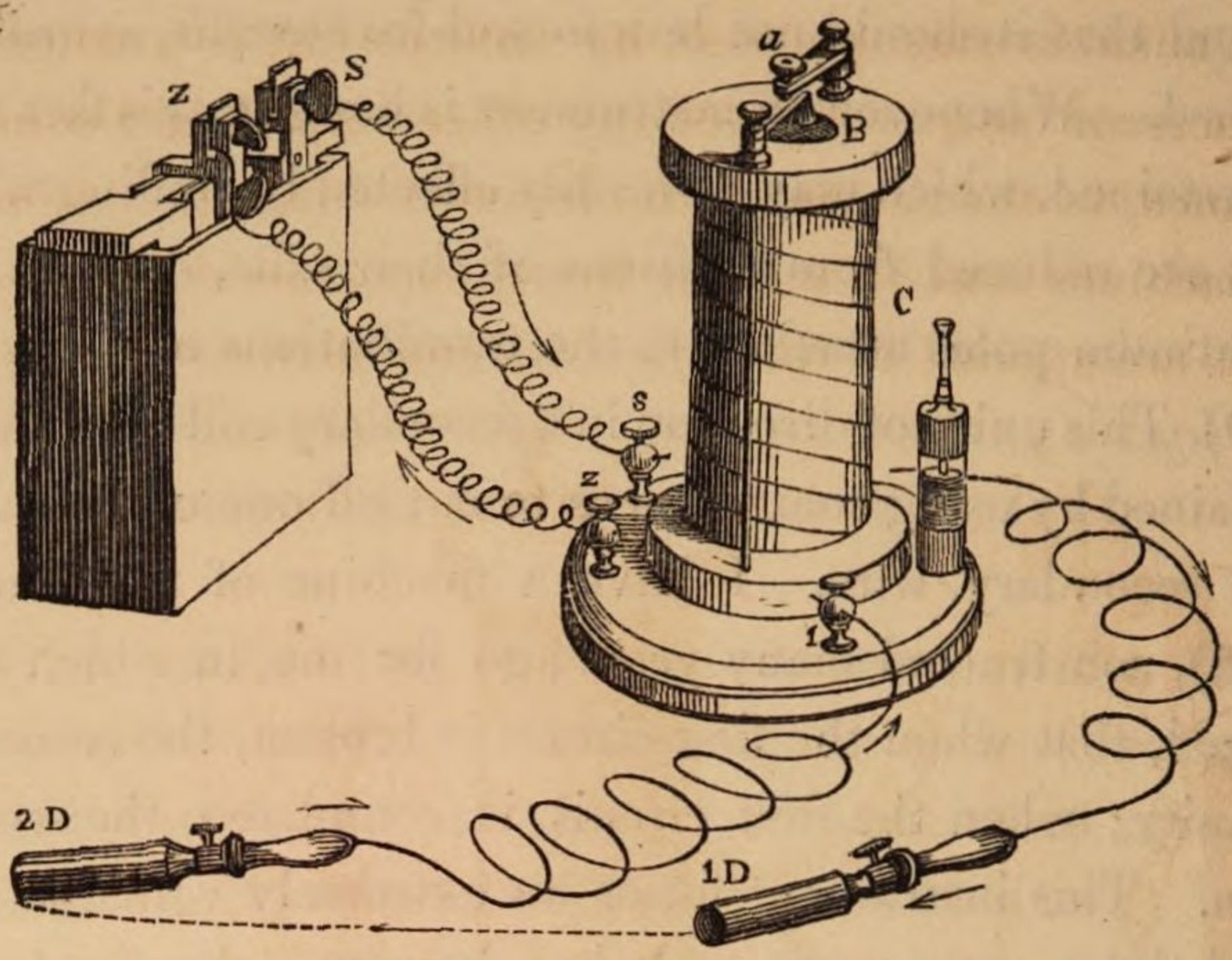

Fig. 17.

and, upon the whole, I think it to be the best contrivance of this kind which the surgeon can employ.

(281). All these various forms of machines give us intensity with but very feeble quantity; and, therefore, are safe in the hands of even the incipient tyro. They should always be marked so as to enable the patient to distinguish between the positive and negative poles.

(282). Whichever form of instrument be adopted, means should be employed to enable the operator to regulate the power of the induced currents. This end may be accomplished by increasing or decreasing the strength of the battery, by either adding more acid when we desire more power, or more water when we desire less. We may obtain the same result by exposing more or less of the platinised silver to the action of the fluid. In the coil, the power may be regulated by employing different lengths of wire, through which we obtain the induced electricity; for the longer the wire, the greater will be the power of the electrical force. We may also regulate the

power by the amount of iron constituting the electro-magnet; for, by withdrawing this, partially or completely, from the influence of the voltaic force, the induced current will be lessened. Lastly, a contrivance may be employed which effectually answers this purpose, by interposing a greater or less thickness of pure water, or any other imperfectly-conducting substance, in the course of the induced current. In some of the machines usually sold in the shops, several of these adaptations are applied to the same instrument (figs. 18, 19, 20).

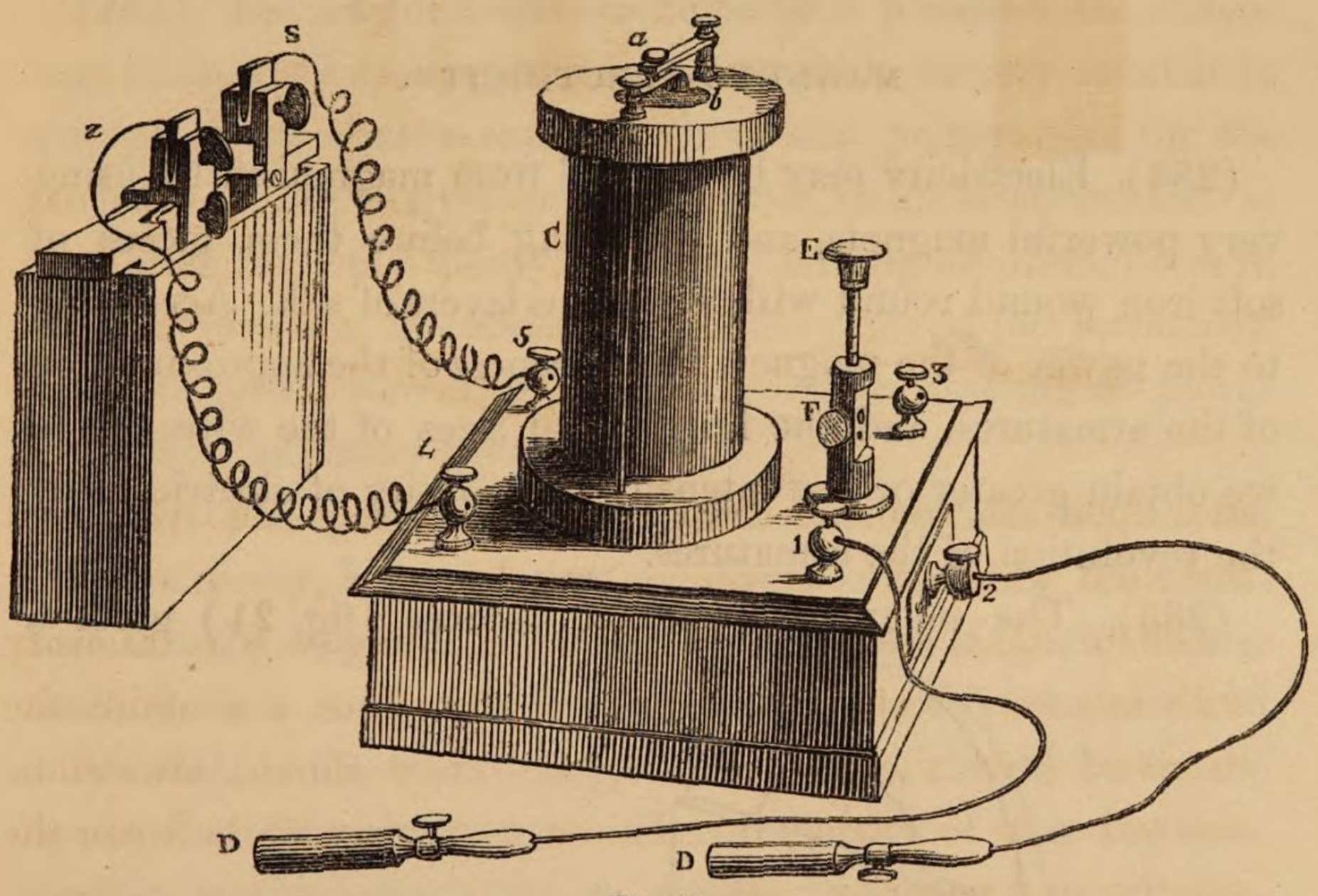

Fig. 18.

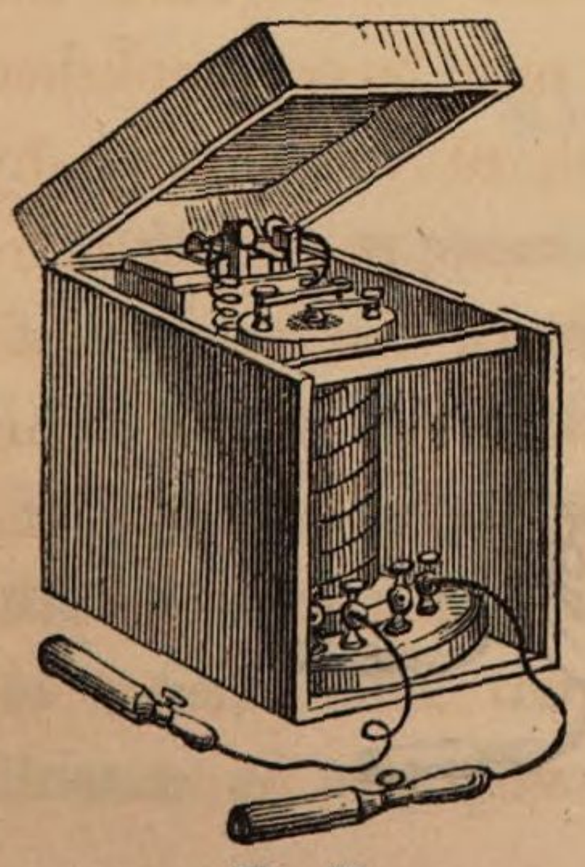

Fig. 19.

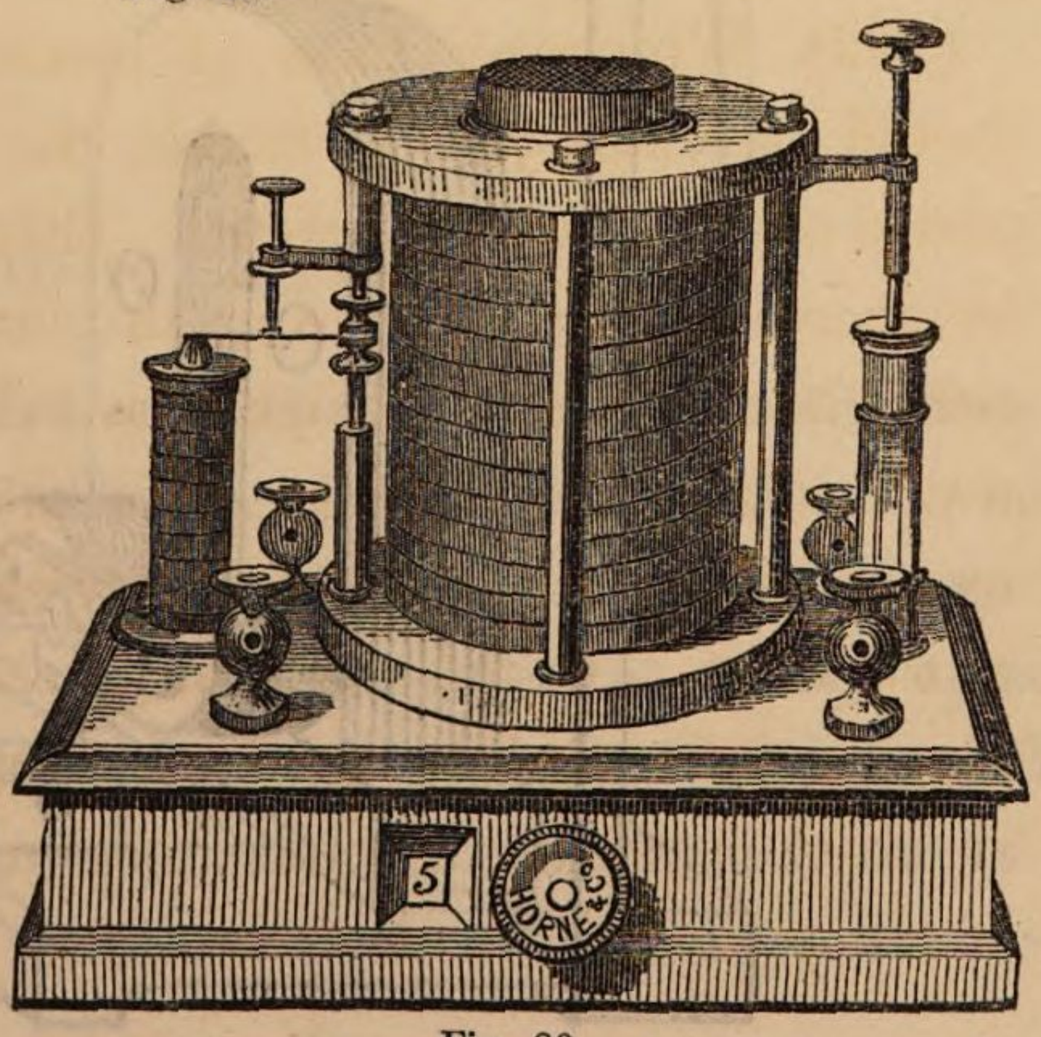

Fig. 20.

(283). The electricity set in motion from these machines, is distinguished by its small quantity and high intensity. It determines the action of the aisthenic pole of the peripheral battery. It also strongly stimulates the action of the dynamic pole, causing powerful contraction of the muscles. This form of electricity acts upon the capillaries, and produces redness, and perhaps may thus even influence nutrition, secretion, and excretion; but its practical application will hereafter be considered in minute detail.

MAGNETO-ELECTRICITY.

(284). Electricity may be derived from magnetism by using very powerful magnets, and revolving before them pieces of soft iron wound round with numerous layers of silk. According to the power of the magnet, the closeness of the approximation of the armatures, and the length and sizes of the wires, so do we obtain greater or less intensity or quantity of electricity by the revolution of the armatures.

(285). The magneto-electric apparatus (fig. 21) gives a

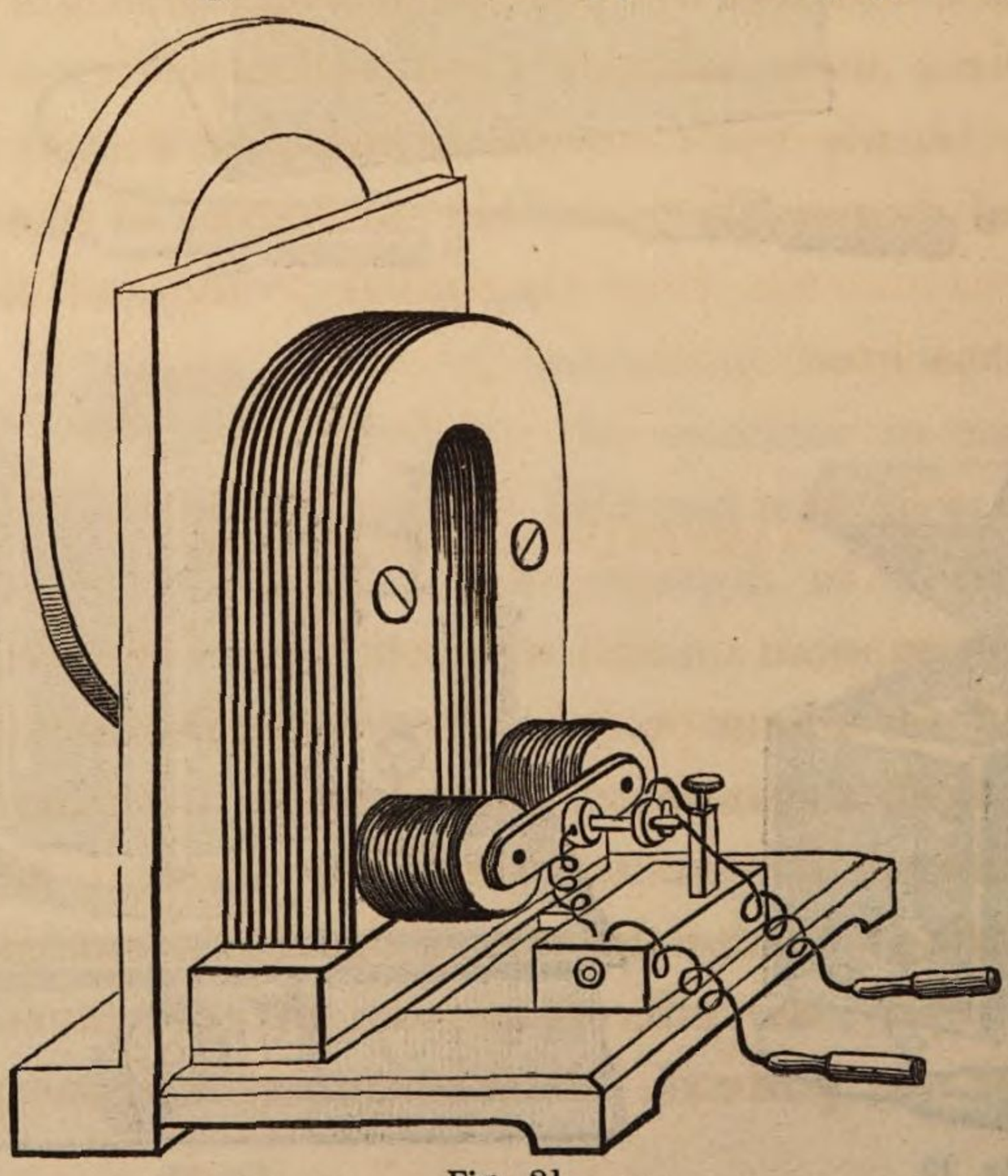

Fig. 21.

to-and-fro current, but it may be readily contrived so that every alternate current may be cut off. When thus arranged, it has been found to evolve so much electricity, that a patent has been taken out for the purpose of conducting electro-metallurgic operations by its influence.

(286). It is a curious fact, that although this machine gives an intermittent current it causes a constant deflection of a magnetic needle; so that, in its chemical effect, it is equivalent to a constant current, producing similar effects.

(287). The magneto-electric apparatus possesses an advantage in its not requiring the aid of a voltaic battery to set it in action. It is always ready, without any preparation, for the purposes of the analyst or therapeutist, in all weathers and at all times. Its only disadvantage is a trifling additional cost in the first instance, in consequence of the price of the permanent magnets, and it moreover requires a certain amount of power to keep its armature revolving.

(288). The power of the current can be adjusted to the greatest nicety, by regulating the distance between the armature and the magnets. Upon the whole, the magneto-electric machine is a most valuable electro-therapeutic engine; and either this, or the electro-magnetic machine, should be in the hands of every practitioner. The properties of the magneto-electric machine are precisely similar to those of the electro-magnetic machine.

MAGNETO-THERAPEUTICS.

(289). A supposition that magnetism can influence the body has existed for a long period. Pereira states that Œtius, who lived A.D. 550, mentions its application for the cure of disease. To ascertain whether magnetism was competent to act upon the capillaries, I placed the web of the frog's foot, and the tail of a fish under the microscope, and exposed them to the influence of very powerful electro-magnets without producing

the slightest effect upon the circulation of the blood. I have also subjected the various organs of sensation to the action of powerful magnets, but have not produced the slightest effect upon either the eye, ear, nose, tongue, or skin. From these experiments, we may safely infer that magnetism has either no influence at all, or but very little, on the functions of animal life. It is stated that Dr. Faraday allowed Dr. Keil to endeavour to affect him with powerful magnets, but without any result being produced.

(290). In this work I have demonstrated that the functions of animal life are really voltaic; and as there is no known method of either increasing or decreasing the action in the voltaic battery, by magnets placed near either the positive or negative pole, we cannot be surprised that the voltaic actions taking place in the body should also remain uninfluenced.

(291). I have not been more fortunate in obtaining positive results in my experiments upon cell life. I placed mustard-seed at different poles of the magnet, but I could not perceive that the growth at either pole was interfered with. The experiments are negative, and therefore are comparatively of but trifling value. I think the subject still deserves further investigation, for I should not be at all surprised to find some action, even if it be but trifling, on cell growth.

(292). Whilst recording a doubt upon the power of magnetism to affect the human frame, I ought to state that so distinguished an ornament of our profession as Laennec, declares that he has frequently relieved neuralgic pains in the lungs by the long-continued use of two magnetised plates, one applied at the back, the other on the front part of the chest. He also speaks most highly of the use of magnetism in angina pectoris, and even states that it has succeeded better in his hands than any other plan. Laennec further mentions that he has observed pimples, which are very painful, to appear at the anterior plate. It appears to me, however, that these effects would be produced by the plates even if unmagnetised, because I find that if any

part of the skin be covered up, so that no evaporation can take place therefrom, considerable irritation results. From all the above facts and experiments, we may safely affirm, that magnetism does not materially influence the organic or cell life, more than it does the animal or nerve life; and if this force has any action, it is almost inappreciable.

ELECTRO-THERMO THERAPEUTICS.

(293). Heat may be produced in two ways by electricity. In the first method, heat may be evolved by the disruptive discharge between the two poles of a voltaic battery, where disintegration is effected, and the particles of one pole pass over to the other, with the evolution of intense light, and great heat. It has been proposed to use this heat for cauterising; but it appears to me not so eligible as a plan presently to be noticed; and, moreover, it would require a long series of batteries, to effect the object in this manner. The second method of obtaining electric heat, is by passing an intense current through any part, either of the solid or fluid part of the voltaic circuit, when intense heat is produced. In this manner, if a powerful current be passed through a very small portion of fluid, it may be made to boil instantaneously, and thus produce unpleasant effects. I mention this, to caution the electro-therapeutist never to boil any part of his patient,—an effect which might readily be produced when large series of batteries are employed. This mode of generating heat does not appear to me calculated to be of utility for the cure of diseases.

(294). Heat is evolved when a certain amount of electricity is forced through a wire, which, from its small diameter, is incapable of conducting it quietly. This heat may be readily made to exceed that obtainable by any other process, except that of the oxyhydrogen blowpipe, as platinum may be made to run like wax by the electric force. The generation of a

high temperature by electricity, requires large batteries. Either two or three troughs of platinised silver batteries (fig. 22) may be used; or a series of the sulphate of copper (fig. 23), or nitric-acid batteries (fig. 24), or even the old Woollaston trough (fig. 25) may be employed for that purpose. This is the only instance

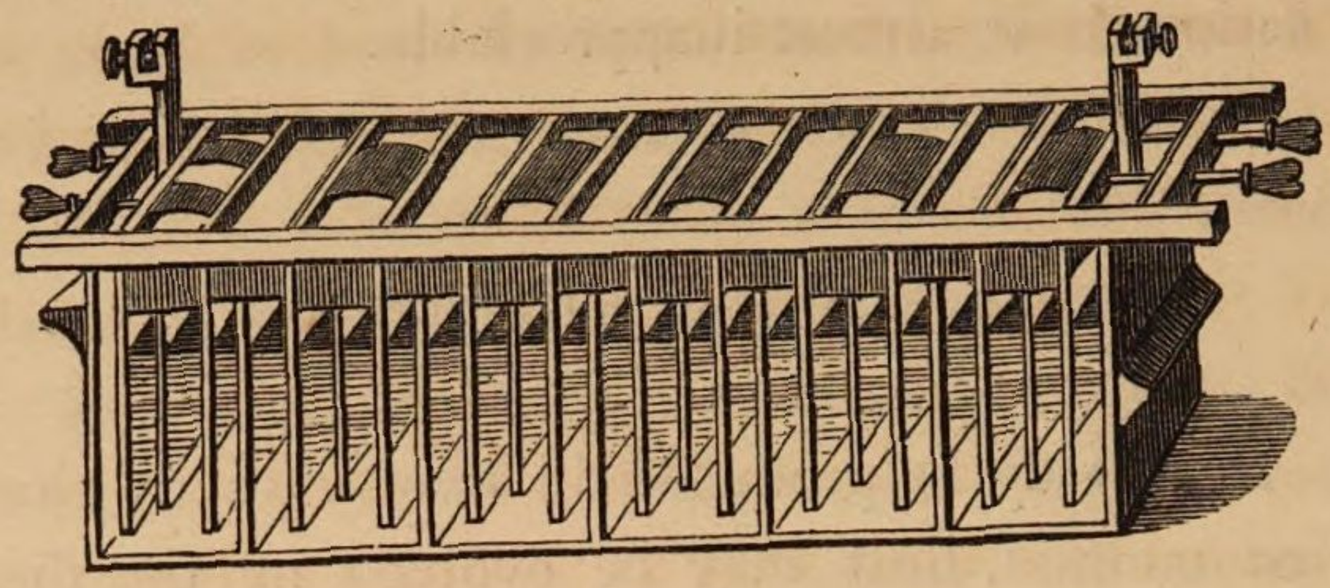

Fig 22.

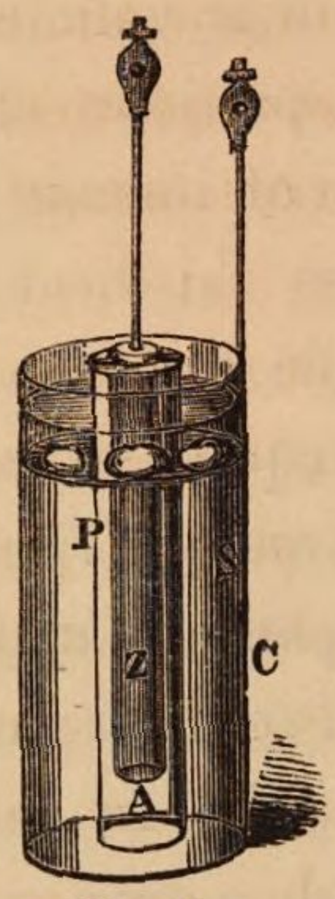

Fig. 23.

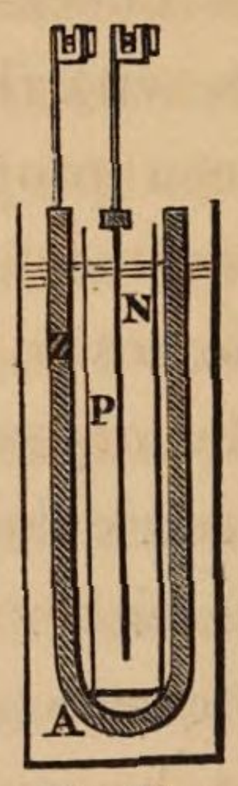

Fig. 24.

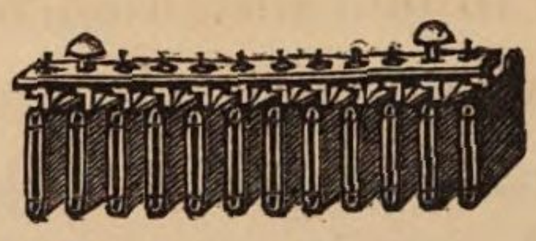

Fig. 25.

in which, I conceive, the surgeon can have any doubt as to the battery which it is advisable to select; and here, I believe, that the platinised silver battery will be found to suit his purpose best.

(295). There can be no question but that the electric cautery should supersede every other application of intense heat to the human frame. Its manageable character, by which the temperature may be raised to the nicest point; and its duration

regulated to the smallest fraction of time, gives it a very decided advantage over all other methods whatsoever.

(296). Inasmuch as the electro-thermal cautery may be of any magnitude, beginning with the finest platinum wire which Woollaston taught us to draw, it can be applied to all parts, and used under all circumstances. For instance, to stop the bleeding of a tooth when other means have failed; a bent wire might be introduced into the cavity, and the part instantaneously destroyed by passing the voltaic current through the wire.

(297). Again, if a platinum wire is coiled into a spiral, it may be heated to a white heat by passing a sufficient electrical current through it; and then it might serve the office of a cautery. Platinum wires might also be thrust through certain vascular growthsas nœvi, when the parts would be destroyed by passing a current through them.

(298). It is hardly my business at the present time, to point out each specific instance in which the electrical heat may be employed by the surgeon, for the medical practitioner should select such means as may enable him to obtain the desired result with the least inconvenience. In using electric heat, the only circumstance to be prevented is the fusion of the wires; this, however, may always be obviated, by trying the experiment with the same length of wire prior to its application to the human body.

ELECTRO-PHOTO THERAPEUTICS.

(299). The public were thrown into great excitement last autumn, by hearing that the electric light, produced by the disruptive discharge, would probably supersede all other modes of illumination. Success, however, entirely depends upon its cost, and this probably will prevent its extensive application for the purposes of mankind. The electric light

abounds in chemical rays, and thus approaches in some degree to the light of the sun, and perhaps would have some chemical effect on the body. There is only one use to which I conceive it might be applied by the surgeon, namely, to ascertain whether total blindness existed, as the intensity of the light is so great, that it would readily act through the partially opaque matters which usually veil sight.

ELECTROLYTIC THERAPEUTICS.

(300). Voltaic electricity decomposes all binary compounds. It resolves water into its elements, oxygen and hydrogen; and salts into their acids and bases. Various propositions have been made to use this property for the cure of disease; and I have seen recommendations to employ it for cataract, by inserting one needle into one part of the lens, and a second into another. Nothing but the most frightful ignorance could have dictated such a recommendation. I tried the experiment upon the eye of a perfectly healthy rabbit; the poor beast appeared to suffer the most excruciating agony. The ball of the eye was distended with gas on the application of the current; the cornea, in a few minutes, became quite opaque, and the whole eye was finally destroyed.

(301). It has also been proposed to attempt to coagulate the blood in an aneurismal sac upon electrolytic principles; but I can only regard such proposals as fraught with danger, in consequence of the disorganisation which experience has shewn is likely to ensue.

(302). In the electrolytic effects of the voltaic force, we must not forget the effects due to the development of acid and oxygen at the positive pole; of hydrogen and alkali at the negative. At the positive pole, or that pole connected with the silver of the battery, rapid disorganisation ensues, if the battery be sufficiently powerful. In this process vesica-

tion first takes place, after which the parts are destroyed. I have even observed a battery, consisting only of twelve cells, to disorganise the soft parts of a frog. It is, however, a painful process, and one not to be followed as a general rule. The electro-thermal cautery would be far more rapid in its action, and less painful.

(303). This power of disorganisation, however, should be borne in mind; and perhaps in certain cases of indolent ulcers it might occasionally be turned to good account. For electrolytic purposes, the Electro-Therapeutic battery, of from ten to fifty small cells, should be used.

THERMO-ELECTRO-THERAPEUTICS.

(304). To take a comprehensive view of Electro-Therapeutics, we must not confine our attention alone to the method in which the various forms of electricity may act upon the voltaic currents in the body, but we must consider how far other agents may produce a similar action. To enter into such considerations, the detail would much exceed the limits which I have assigned to myself in this treatise, and therefore I shall but very briefly advert to them.

(305). Of all agents which act upon the human frame, perhaps, variations in temperature produce the most potent results. Heat and cold are great surgical weapons, with which most extensive results may be produccd. In all voltaic arrangements, we find that heat increases the action, cold retards it. In Electro-Metallurgic operations, the difference between summer and winter is strikingly exemplified; and when hot weather has suddenly set in, I have been frequently inundated with letters from all parts of the country soliciting information, as the operators found that their processes had run wild.

(306). From these experiments it follows, that the phenomena of animal life which depend upon electric currents are

entirely controlled by heat and cold. Heat first excites, then exhausts the powers of the part on which it acts; cold depresses them at last to total inaction. As in the voltaic battery sufficient cold will always stop action, so in the human body deficiency of temperature will cause the cessation of feeling, and even of life itself. Cold is extremely valuable in causing sleep; and a cold cloth to the top of the head, or the application of cold water over the body till chilliness is produced, will produce sleep after all narcotics have failed, or under circumstances when they are inadmissible. The most violent paroxysms of hysteria and insanity have in my hands yielded to cold applications, when other means have been tried and failed.

(307). The influence of temperature on cell life is equally conspicuous, as we find that each plant and each animal has a certain temperature at which it best thrives; and that any deviation therefrom interferes with its nutrition and growth. Inasmuch as we are but ill acquainted with the forces of cell-life, it is uncertain whether these results are due to the influence on electrical currents.

(308). Variations in temperature act powerfully upon the whole bio-dynamic circuit;—they influence the aisthenic pole, or all the organs of sensation: they influence the dynamic pole, or the entire muscular system: and lastly, they have important effects on pain, delirium, inflammation, rheumatism, and all other diseases in which the electro-nervous power is concerned.

PHOTO-ELECTRO THERAPEUTICS.

(309). The light of the sun may determine certain voltaic combinations, which I have described under the term of "Photo-Voltaic Circuits." Light stimulates to action the aisthenic pole of the peripheral battery; and for the eye, or opsaisthenic pole, it is the normal stimulant. Light also seems to affect the cell-life of animated beings. Some time since, I crossed the

Furca pass in Switzerland, one intensely bright day in the middle of June, with two or three parties, composed of persons from different nations; and the next morning, I observed that the skin was peeled from the face of every tourist but myself. Light also tends to the production of the *coup de soleil,* of which I have seen only a solitary instance: this is another example of the effect of light upon the body.

(310). An absence of light causes persons so deprived to evince certain peculiarities; and when confined in dungeons, cellars, or in the dark courts of London, they become blanched or etoliated, like celery, endive, or lettuces, on which light is not allowed to act.

PSYCHO-ELECTRO THERAPEUTICS.

(311). As we may affect the electro-biological circuit by physical forces acting upon the peripheral battery, so may we also produce an influence upon man by impressions acting upon the central batteries. In proportion as these impressions influence the higher batteries, so are the effects more exalted. From this cause, moral emotions produce great effects upon the body, and frequently cause instant death. Pettigrew has collected many curious cases, where joy, grief, or rage, has instantly exhausted the electro-biological circuit, and caused death.

(312). These cases form extreme instances of the action of psycho-electric impressions. Upon the whole, to act upon the body through the medium of these impressions, is a thing generally to be avoided by the medical profession. Nevertheless, the value of our art is greatly enhanced by holding out, on the one hand, every fair hope; and, on the other hand, by making the patient understand the results which probably he has to fear, where he shews a tendency to neglect himself. In every instance, a psycho-therapeutic impression should be within the strictest bounds of truth.

(313). I need hardly notice that diet, exercise, climate, and the use of various medicines, must have very important bearings upon the supply of matter to the body in keeping its voltaic batteries duly charged. In many instances, however, the working operation of any specific material is quite unknown, and not even the vaguest theory can be assigned for the mode of action of any particular agent.

(314). The great influence of diet is doubtless to supply proper materials for the body through the blood. Food, however, has to provide for cell-life, as well as the electro-life,—a circumstance which must be considered. After a severe loss of blood, the functions of animal life are suspended, and cannot be performed. In this instance, we obtain good results from charging the batteries, by the process of transfusion, with blood drawn from another individual. I know two or three cases in which life has been preserved by this proceeding. The blood should be selected from the same animal, the same sex, and if possible, from the same family.

(315). The use of water, either in excess or scarcity, will also act a very important electro-therapeutic part. In a voltaic battery, its relation to the exciting material, or acid, regulates the action of the battery; and a different effect is produced when the water is added little by little, and when it is added at once. An excess of water suddenly taken into the blood causes instantaneous death; and it is said, that Alexander the Great lost more men from drinking cold water, than ever he lost in one day in battle.

(316). The action of the wind has a very decided electro-therapeutic effect. In high gales, great pressure is made upon the whole surface of the body, and the aisthenic pole is thereby excited to action.

(317). Pressure, friction, especially by coarse towels and

horse-hair gloves, has a very decided effect in producing electro-therapeutic effects; and there is no method better adapted to excite the aisthenic pole, than brisk friction.

(318). By taking a cursory view of the entire subject of electro-therapeutics, we perceive that it is a contracted and erroneous notion to suppose that the electro-biological circuit is alone influenced by electricity. All forces have their origin in change of matter, and this change of matter may be ultimately resolvable into a new attraction between its particles. We thus perceive, that all material forces have one common origin, and that each may influence the voltaic currents existing in the body; and, whether the force be that of light, of electricity, of heat, or of ordinary power, it will, under certain circumstances, determine the action of the peripheral batteries in the human body.

Fig. 26.

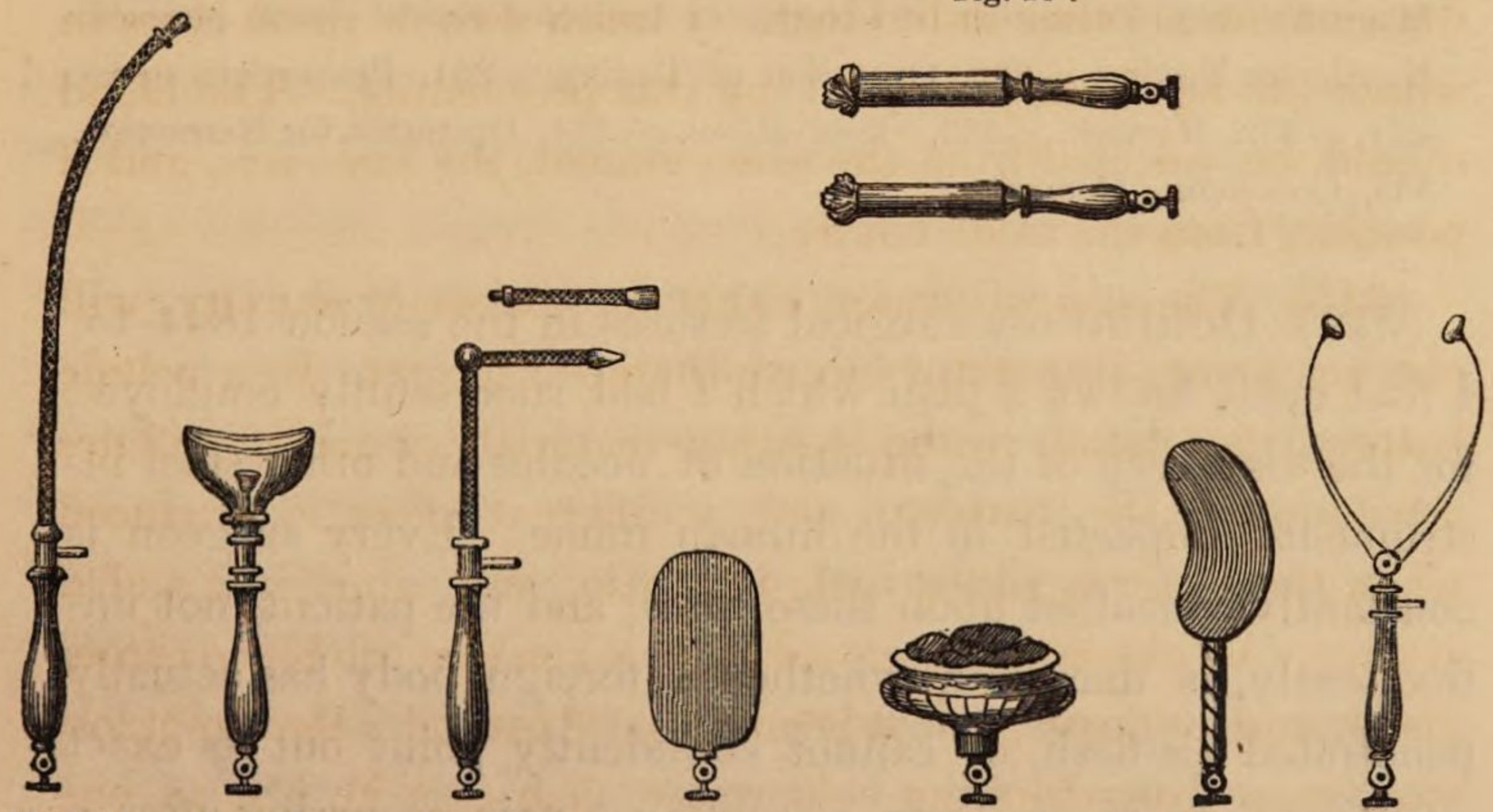

Fig 27. Fig. 28. Fig. 29. Fig. 30. Fig. 31. Fig. 32. Fig. 33.

INSTRUMENTS USED FOR THE APPLICATION OF ELECTRICITY.

CHAPTER ELEVENTH.

ON THE DETECTION OF NEEDLES AND OTHER STEEL INSTRUMENTS IMPACTED IN THE BODY.

319. Needles, etc. in the Human Body. — 320. Difficulty of discovering. — 321. Case of Impaction detailed. — 322. Magnetising the Impacted Steel. — 323. Apparatus for Magnetising. — 324. Form of Battery. — 325. Part where the Electro-Magnet is to be applied; selection of. — 326, 327. Application of Magnet. — 328. Formation of Polarity in Impacted Steel. — 329. Magnetic Needle for Testing. — 330. Operation of Testing. — 331. Precautions necessary. — 332. Remark. — 333. Observations. — 334. Operation for Extraction. 335. Concluding Remarks.

(319). DURING my surgical lectures in the session 1844-45, I first made known a plan which I had successfully employed for the discovery of the situation of needles and other steel instruments impacted in the human frame. Every surgeon is constantly consulted upon these cases; and the patient, not unfrequently, is uncertain whether a foreign body has actually penetrated his flesh, or cannot confidently point out its exact situation. In these cases, a continual pain occurring after a prick, is commonly the only cause for his supposing the presence of a foreign body in the system.

(320). The surgeon may carefully examine the suspected part, and yet, it often happens, that after the utmost scrutiny, he can speak with no more certainty, either of the existence or of the situation of the foreign body, than his patient; for,

although a piece of needle, an inch in length, may be actually imbedded under the skin, the most skilful surgeon may be unable, by any manipulation, to ascertain its presence.

(321). We need not now remain long in this state of uncertainty, for there are means by which we may readily and effectually ascertain the presence or absence of any particle of steel or hard iron. The plan which I have to detail, occurred to my mind from having a sempstress under my care, who, unfortunately, had pierced one of the joints of her fore-finger with a piece of a needle, which had firmly imbedded itself in the bone, and then snapped off. This piece weighed only the sixth of a grain, though it subsequently caused the destruction of the joint, and amputation was only averted by using the utmost care to procure anchilosis. I had no means, at that time, of ascertaining the presence or absence of the needle:—I could not feel it, nor was the patient certain that she had received more than a severe prick at that part.

(322). To detect needles, or any other fragments of steel or hard iron, we take advantage of the well-known laws of magnetism. For this purpose, we magnetise the imbedded fragment, or rather, subject the part suspected to contain steel, to such a force as is competent to convert the iron or steel, if present, into a magnet. This may be done in several modes; for, whether we magnetise by means of a voltaic circuit, an electro-magnet, a permanent magnet, or a loadstone, it matters but little, provided we magnetise, as powerfully as possible, the enclosed object.

(323). I myself prefer, and generally employ a strong Electro-Magnet (fig. 34), consisting of a bar of soft iron, about

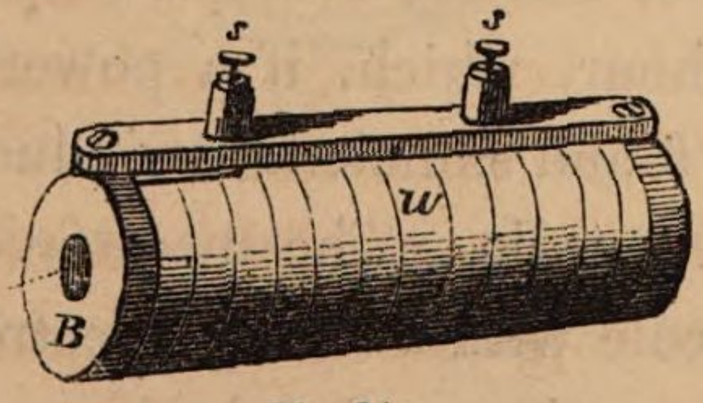

Fig. 34.

three-eighths of an inch in diameter, wound round with wire.

The iron has a plate of brass (B), fixed on both ends to retain the wire (*w*) *in situ*, and the two ends of the wire are attached to binding screws (*s s*), to connect it with the voltaic battery.

(324). Any form of battery may be employed to render the iron magnetic. I use from one (fig. 35) to twelve cells (fig. 10, p. 87)

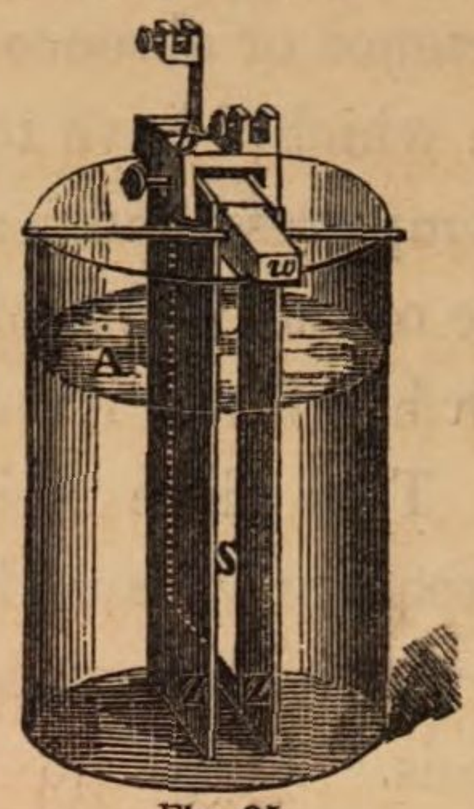

Fig. 35.

of my own form, increasing the number according as I desire to render the magnet more powerful, and to perform the operation more expeditiously.

(325). The Electro-Magnet is to be placed in contact with the skin over the suspected part, and we should select a situation where a possibility of its existence is indicated.

Sometimes we regulate our choice of the situation from the patient feeling some uneasy sensation in a particular spot; at other times the patient will complain of the functions of the part being more or less injured. Occasionally a swelling will give rise to suspicion; and, lastly, the existence of a small mark on the skin, like that of a puncture, will determine the surgeon in his choice.

(326). When the surgeon has chosen his locality, he places the Electro-Magnet exactly over the suspected place for about a quarter of an hour, which, if a powerful battery be used, will generally be found sufficient to induce strong magnetism in the imbedded needle. The most favourable situation for magnetising a needle with a strong Electro-Magnet, is that at which one end is acted upon by the instrument.

(327). After this process has been followed, the part may

be tested for magnetism in the manner in which I shall presently describe; and, if no indications are presented, other spots may be tried. In fact, every part of the body might be subjected to experiment, were it not that the patient would be fatigued, as well as the surgeon, by the tediousness of such an extensive examination.

(328). By the last described means, the imbedded needle is converted into a magnet, and has therefore a north and south pole. These poles have the property of attracting unlike, and of repelling like poles of another magnet. From this peculiarity, we can not only ascertain the presence of magnets, but are even able to learn the position of the two poles of the fragment. It frequently happens, that the impacted portion is magnetised before insertion into the body, and steel pens, needles, knives, etc., are always found to possess more or less magnetism. In such instances, no process of magnetism is required.

(329). To test for magnetism, a magnetic needle is required. On several occasions I have been contented with a magnetised sewing or ladies' knitting-needle, suspended by a film of thread, though I now more usually employ a needle about six inches long, centered upon a small agate cap, resting upon a steel point, which is fixed on a brass stand (fig. 36).

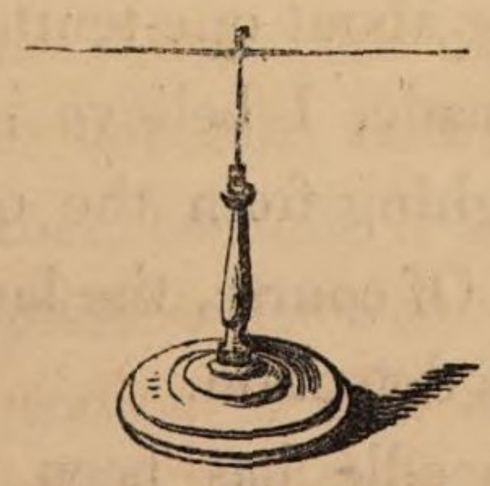

Fig. 36.

The needle should be so arranged, that the smallest possible amount of resistance is offered to its free play.

(330). The suspected part is brought near one pole of the magnetic needle, when, if it contain no magnet, no effect will

be produced; but if there be one present, certain indications will be observed, differing according to the position of the magnet in the body with regard to the pole of the magnetic needle. If the impacted needle be either above or below the magnetic needle, it will only cause it to exhibit agitation; and if the centre of the imbedded fragment be brought near the needle, but little effect will be produced. By gently moving about the suspected part, however, the test-needle will become attracted as soon as the opposite pole of the fragment is approximated to it. The point of greatest attraction indicates the position of one pole of the encased magnet. By moving the suspected part gently about, the operator will at length find the point of repulsion, which indicates the other end of the needle. The surgeon may test the accuracy of his observations, by repeating the experiments with the opposite pole of the test-needle, when the part which caused attraction before will now cause repulsion; the point which caused repulsion, attraction.

(331). To determine the presence, exact situation, and direction of a small piece of steel, patience and skill are frequently required; and the surgeon must be careful to guard against fallacies arising from currents of air caused by breathing, or even at times by the heat of the part subjected to the magnetic test.

(332). I have myself detected, and subsequently extracted several pieces weighing about one-tenth of a grain; and from experiments I have made, I believe it would be possible to extract fragments weighing from the one-sixtieth to the one-hundreth of a grain. Of course, the larger the piece of needle, the easier would be its detection.

(333). After the needle has been magnetised, it will in some cases permanently retain its magnetism. For this reason we need not hurry ourselves to test for magnetism, as in different cases we may repeat our observation for two or three days, in order to ascertain with great exactness the precise spot in which the foreign body is impacted. In other cases

the steel will lose this acquired property, when it will be necessary to re-magnetise it, in order to test its presence. In all instances, I would particularly urge the propriety of a most thorough search by means of the test needle, as the surgeon will never have cause to regret the time as mis-spent in this part of the operation. When the test gives negative results, it requires a long and scrutinising research, before we can inform our patient decidedly that no needle is imbedded in his body.

(334). When positive evidence is obtained of the presence of the foreign body, the surgeon may at once proceed to remove it by incision. Although the operation in itself is generally trifling, unless the needle is imbedded near some vital part, it requires tact to regulate the direction of the incision, if the surgeon hopes to remove the needle. The incision, in all cases, should be made sufficiently deep at one cut, and of a length rarely less than three-fourths of an inch. The direction of the cut is sometimes best made from one magnetic pole towards the other; and at other times the needle will be more readily found, by cutting a little transversely to the axis of the magnet.

In many instances the surgeon will at once find the needle, and be able immediately to extract it with a pair of forceps. In some cases, however, even though the surgeon goes through all the necessary processes with the utmost care, he will not succeed in finding it at one cut; in which case he need not pursue his research farther, because if the cut is made directly over the inclosed fragment, it will generally be speedily thrown out when suppuration is well established. When the surgeon conceives that there is reason for not performing the operation, or when, from any cause, he wishes its delay, the test may be occasionally used to ascertain whether it remains in the same place; or whether, as is the habit with needles, it is making a tour to a more distant part of the body. By the magnetic test we can always know the locality; in fact we

can, with our mind's eye, see that which is invisible to the direct organs of sense.

(335). My experience of the efficacy of the magnetic test for the detection of needles and other steel instruments, leads me to form the highest opinion of its importance in all cases where the object is not to be felt, or its existence ascertained by more direct means. The test, when it gives positive indication, is, so far as I know, infallible. When, after a careful search, we get no evidence, we may safely infer the non-existence of the suspected object. The negative evidence, nevertheless, is not of the same value as the positive. Now that magnetism can with certainty be used to ascertain the locality of steel fragments, no surgeon will be justified in attempting at random to make an incision to extract a needle, when he is uncertain of its exact situation, before he has submitted the suspected part to the magnetic test.

CHAPTER TWELFTH.

ELECTRO-PATHOLOGY.

336. Electro-Pathology: Subdivision of the Subject.—337. Diseases arising from alterations in the blood: Classification of.—338. Electro-Pathology of.—339 Obstructed Circulation in Capillaries.—340. Exudation and Imbibition: Dropsy.—341. Treatment of: Endosmosis and Exosmosis.—342. Hæmorrhage, without division of Vessels.—343. Hæmorrhage from divided Vessels: Electric Treatment of.—344, 345. Atrophy and Hypertrophy.—346. Reparation: New Growths.—347. Ulcer: Ulceration.—348. Cicatrization.—349. Pathology of Inflammation.—350. Relation with Electricity considered.—351. Fever.—352. Rheumatism: its Characteristics: Acute form: Effect of Electricity in the Chronic form.—353. Scrofula and Phthisis: Tubercle: Electric Relation.—354. Cod-Liver Oil: Action of, in Tubercular Diseases.—355. Cancer.—356. Syphilis.—357. Glanders.—358. Cysts.—359. Entozoa and Parasites.—360. Diseases of Sensation.—361. Anasthesia: Employment of Electricity in.—362. Neuralgia: Electricity and Aconitine.—363. Diseases of Vision.—364. Use of Electricity in.—365. Deafness: Morbid Acuteness of Hearing.—366. Diseases of Smelling.—367. Of Taste.—368. Patho-Dynamics.—369. Tonic Spasms.—370. Electricity, Ether, Chloroform.—371. Hydrophobia.—372. Cramp.—373. Cough, Sneezing, Hiccup, and other Clonic Spasms.—374. Chorea: Electrical Treatment.—375. Trembling, etc. etc.—376. Electro-Patho-Noemics: Disease of Memory.—377. Idiotcy.—378. Giddiness.—379. Delirium: Delirium Tremens.—380. Insensibility: Use of Electricity.—381. Desire for Action: Relation to Crime.—382. Insanity: Phreno-Aisthenic Battery.—383. Syndramic Battery.—384, Erroneous Action of other Batteries.—385. Aisthenic-Noemics: Syndramic Noemics.—386. Other Instances: Phreno-Aisthenic Battery.—387. Action from False Impression.—388. Controlling Effect of Moral Impression.—389. Management of Lunatics.—390. Lesser Mental Derangements.—391. Voltaic explanation.—392. Over-work of Brain.—393. Absence of Mind, Sleep-walking, etc.—394. Fits.—395. Epilepsy: Nature and Treatment of.—396. Coma.—397. Fainting.—398. Hysteria.—399. Collapse.—400. Indigestion.—

401. Employment of Electricity in. — 402. Amenorrhea. — 403. Use of Electricity in. — 404. Barrenness. — 405. Uterine Inertia. — 406. Uterine Bleeding. — 407. Asthma. — 408. Asphyxia. — 409. Abnormal State of Secretion and Excretion. — 410. Relation of Electricity to the Kidneys, Liver, and Alimentary Canal. — 411. Collapse from Cholera, — 412. Functions of Skin. — 413. Electricity compared with other Remedies, generally. Conclusion.

(336). In studying the electrical relations of diseases, we find that they are presented to our notice under several heads Firstly, we have diseases of the blood, or exciting fluid of the electro-biological circuit; secondly, we have diseases of the central and peripheral parenchyma and of the nervous media, which serve as telegraphs to connect them together: we have then to study the electric relations of growth and nutrition with the abnormal tissues and products occasionally produced: and we have lastly to study the deviation from the usual actions of health.

DISEASES OF THE BLOOD.

(337). The researches of modern chemists have done much to elucidate the pathology of the blood. This material is liable to various important alterations, and perhaps the classification of these adopted by Simon is to be preferred. He separates them into four classes: in the first class (hyperinosis) the fibrin and fat are increased, — the corpuscules diminished: this state is observed in pleuritis, peritonitis, nephritis, carditis, acute rheumatism, erysipelas, phthisis, puerperal fever. In the second class (hypinosis), the corpuscules are increased, the fibrin diminished, a condition which is found in typhus, continued fever, small-pox, scarlet fever, cerebral hæmorrhage. The third class (spanæmia), comprises cases in which both the fibrin and corpuscules are less, whilst the water is increased: this condition is observed in anemia, carcinoma, scrofula, chlorosis, scurvy, yellow fever, and plague. The last class (hetrochymeusis) embraces those instances in which new matters are

contained in the blood; as, for instance, uræmia, where urea is found in the blood, which is the case in Bright's disease, and in cholera, etc. Sometimes bile is found in the blood, which is termed cholæmia. Occasionally fat, or even animalculæ, may be detected; and under certain circumstances, a great variety of other matters may be detected in this fluid.

(338). In all these cases, the blood is actually altered in quality, and therefore its power to effectually charge the batteries, and to enable them to perform the various vital functions in a healthy manner, is also altered. There is no known method, however, by which electricity can be brought to bear, to alter any of these states, which are manifestly electro-pathological.

IMPERFECT DISTRIBUTION OF THE BLOOD.

(339). Healthy arterial blood should be regularly and equably distributed throughout all the capillaries of the body. It frequently happens, however, that it leaves one part and engorges another. From experiments detailed in a former part of this book, it was shewn, that the circulation through the capillaries is materially influenced by electrical currents; and hence, we have aright to conclude, that these arrangements are influenced by the ordinary voltaic currents which exist in the electro-biological circuit. In these cases, the line of treatment indicated, is to equalise the distribution of blood by drawing it to remote parts which are unsupplied. Perhaps electricity might be beneficially employed; but the agency of heat and cold in some instances, and of friction in others, produces results which, acting upon electric principles, are sometimes preferable to the immediate influence of electricity itself, and may be regarded in every way, as electro-therapeutic. In a former chapter, I have demonstrated the important influence of electricity on the capillary circulation.

DROPSY.

(340). Besides the circulation of the blood in the capillaries, there appears to be an exudation and imbibition, by which the fluid passes out of the vessels and lubricates various tissues, which thus receive the material by which they are nourished. In some instances, the fluid becomes more watery, and is not again taken into the capillaries, giving rise, when it is left in the cellular tissue, to œdema,—in the peritoneum, to anasarca,—in the pleura, to hydro-thorax,—in the pericardium, to hydro-pericardium,—in the tunica vaginalis, to hydrocele,—in the ventricles of the brain, to hydrocephalus.

(341). This exudation and imbibition is perhaps perfectly explicable upon the laws of endosmosis and exosmosis; and it is unknown whether voltaic electricity can either increase or decrease these effects. Any electro-therapeutic agent might cause more blood to be supplied to the part, and thus perhaps help, to a certain extent, the cure of this affection, though our treatment for these maladies is directed to the removal of the water from the blood, by excreting it from the kidneys, intestines, or skin. By thus inspissating the blood, the fluid is absorbed upon the known laws of endosmosis and exosmosis. In most dropsical diseases, not only is the relation of water to the solid materials altered, but perhaps the composition of both blood and serum is also altered in some other respects.

HÆMORRHAGE.

(342). Bleeding may take place, according to the belief of some pathologists, without the actual laceration of the vessels themselves, in which case the bleeding is called "Medical Hæmorrhage." This is seen in bleeding from the lungs, or Hæmoptysis; in bleeding from the nose (Epistaxis)—in

Purpura, and other disorders. In all these cases, there is either a vitiation of the qualities of the blood, or an irregular distribution. Electricity has not yet been applied with benefit in such cases.

(343). Where blood-vessels are actually divided, the bleeding is denominated "Surgical Bleeding"; and upon this, electricity might be brought to bear with advantage through its property of disorganisation, as in Electrolytic Therapeutics; or by its property of generating heat, as in Electro-Thermo-Therapeutics. In these cases, the neighbouring parts are destroyed, the arteries clogged up with lymph, and thus the bleeding is prevented. Electro-thermo-therapeutics may be frequently used as a valuable surgical appliance, when other means could not possibly be employed.

ATROPHY AND HYPERTROPHY.

(344). Both an imperfect and excessive nutrition are states frequently observed. In neither case, however, as a general rule, do they appear to be owing to voltaic causes. The nutrition of some tissues is subservient to their employment, as muscle wastes when disused, and grows when much employed. In these cases, the nutrition appears directly owing to voltaic effects; and hereafter, I shall demonstrate that it is really promoted by the agency of electricity. In other instances, as in the nutrition of bone, no such cause is to be found, as osseous tissue neither increases nor decreases with a corresponding variation of the exercise.

(345). Various parts of the body are preternaturally increased or decreased in their first development, which is similar to Atrophy and Hypertrophy. In the diminutive Tom Thumb, and in the gigantic O'Brien, we have instances of general variations from the proper standard. Neither state, as far as we know, is influenced by electricity; nor does it appear

probable that the electro-therapeutist can in any way regulate the matter.

REPARATION.

(346). After injuries to the body, either from external actions, or from internal diseases, new growths occur, and reparation ensues. These changes differ but little from the original development of the organ, as reparation is always produced by cells, like those observed in original formation; and the same uncertainty exists with respect to the share which the electro-biological currents have on their arrangement. It is true that electricity may be used advantageously through its chemical or thermal powers, and even by its capacity to stimulate the capillaries. In these instances, its action would be secondary, and no direct effect of electricity would be shewn upon the cells themselves.

ULCERATION.

(347). The term, "Ulcer," is assigned to any breach of surface in the body, whether caused by any external force, or internal disease. Whether the destruction or removal of the portion of the body arise from heat, force, chemical or irritating agents; or whether it be taken into the system by absorption, the unhealed surface where the gap exists is termed an Ulcer. When we speak, however, of ulceration, we imply that a portion of the body is being removed by absorption; and that the materials of which it was composed are being taken into the system.

(348). Before an external ulcer heals, cytoblastena is deposited, in which cells are formed. These first give rise to granulations, which, as soon as they become level with the adjacent parts, are covered with a persistant membrane, which process is called "Cicatrisation." I need hardly again repeat the relation of electricity to reparation. But in all

states of ulceration, we should bear in mind the electrolytic, the thermal, and the stimulating power of electricity, which may be directly applied in all cases where the healing process is imperfect. In each individual instance, the surgeon must be guided according to circumstances, in the preference of electricity to other means of obtaining the same results; and of course he would choose that which he might deem most effectual, and most easy of application.

INFLAMMATION.

(349.) Inflammation may be defined to be an abnormal action of the body, tending to the formation of pus. Now, pus is an organic cell, which differs from the ordinary cells of which the body is built up; and the same obscurity which appertains to the electro-physiology of ordinary cells, appertains also to that of the pus corpuscule. When inflammation occurs, we have an increase of temperature, greater vascularity, a deviation in the ordinary sensation, amounting generally to absolute pain, and a greater or less impairment of the ordinary functions of either the aisthenic or dynamic poles of the peripheral battery. From these results, it is apparent that inflammation involves the electro-biological circuit. Adhesive lymph occurring in connection with inflammation, has been proved by modern pathologists to contain, in all cases, pus corpuscules.

(350). Whether, conversely, electro-therapeutics can benefit inflammation, is a question now to be considered; and the application of cold to prevent inflammation; of heat, by poultices, fomentations, and like appliances to exhaust it when it actually has occurred, may be perhaps regarded as thermo-electro-therapeutic influences. The direct influence of electricity upon this disease has not yet been ascertained, though no surgeon can well doubt, that in the chronic, indolent forms, it may be used beneficially as a stimulus. For this purpose, the electricity should be derived from the electro-magnetic, or magneto-electric apparatus.

FEVER.

(351). The essential character of Fevers is perhaps less understood than that of inflammation. The total absence of feeling and motion in severe cases, indicates a great derangement of the functions of the electro-biological circuit. I have already mentioned that the blood is greatly at fault in fevers, which sufficiently accounts for the cessation of the functions of the electro-biological circuit. We do not know whether the diseased state of the blood is the primary cause of the phenomena of fever; or whether other changes are taking place in the nutrition of the body, through the cells of which it is composed. Lastly, we are ignorant whether fever is a malady in which the electro-biological actions are alone at fault. In this uncertainty, we cannot judge of the relation of electricity to fever; nor can we pass any opinion upon the possible benefit of electricity, used in any manner as a curative agent.

RHEUMATISM.

(352). Rheumatism may be defined to be an abnormal action, with the excessive formation of lithates. It is distinguished from inflammation by the difference of the character of the new matters, by the excessive pain which it causes, and by its tendency to shift suddenly from one part of the body to another. From these considerations, it appears to be a disease which rather appertains to the Electro-Biological circuit, than to the cell-life. Rheumatism may therefore be classed under Electro-Pathological states. Before we can employ electricity for its treatment, it is either necessary to remove the excess of lithates, by acting upon the kidneys by the salts of potash, sweet spirits of nitre, or other similar remedies; or to stop the morbid action by colchicum, which

has an influence on the disease upon some unknown principle. In Chronic Rheumatism, however, when these results have been obtained, electricity presents itself to our notice as an invaluable auxiliary to our treatment. I have frequently seen it remove old standing diseases about the joints, when other remedies have failed to be beneficial. It should be employed daily from ten minutes to half an hour, and as much electricity should be used as the patient can comfortably bear. The Electro-Magnetic, and Magneto-Electric machines, are best adapted for this purpose. One pole should be applied to the sole of the foot, or palm of the hands, whilst the other is moved all over the skin of the limb, especially near the affected parts, to excite all parts to action.

SCROFULA, CONSUMPTION, ETC.

(353). Scrofula, Consumption, and other diseases emanating from the production of tubercle, differ remarkably from Rheumatism and Inflammation, inasmuch as they exhibit a deviation of the normal cell-life with but little variation in the action of the Electro-Biological circuit. In these maladies we observe a great amount of organic disease, accompanied with very little pain, very little impairment of the power of motion, or other functions of the diseased part, compared with the impairment which would have been produced with the same amount of change in Inflammation or Rheumatism. Scrofula, in its widest signification, may be defined to be an abnormal action, with the production of tuberculous matter. Tubercle is an organic cell which is produced under certain circumstances, and is generally accompanied by the absorption of the ordinary material of which the cells are built up. If we suppose that tubercular cells obey the laws of the normal cells of the body, we find that it is highly doubtful whether the voltaic currents in the body influence their development

or growth to any great extent. From these considerations, we may question the utility of using electricity as a remedial agent for these growths. As a matter of experience, we find that it is advisable to regulate the action of the aisthenic pole in these cases, by applying friction to the skin, or exposing it to the influence of light or radiant heat. On this account electricity must act beneficially as a similar stimulus to these parts, though I have not found it sufficiently advantageous to employ it, except in cases where the patient himself has desired it; and even in such cases it should never be allowed to cause any distress.

(354). The beneficial action of cod's-liver oil in these cases may possibly, in part, depend upon its influence on the aisthenic pole, in which situation it is manifestly deposited in the form of fat. I have frequently watched, with intense interest, the disappearance of large masses of tubercular matters during its administration, when every known line of treatment had failed. This absorption, however, we may expect to be due to other causes than its influence on the aisthenic pole; and perhaps, in these instances, it may traverse by imbibition, or give to the serous portion of the blood a power of traversing the non-vascular parts, and thus enable abnormal matter there deposited to be absorbed.

CANCER.

(355). Cancer, like scrofula and inflammation, consists of an abnormal organic cell, which, however, differs from both tubercle and pus in its physical characters. It is doubtful whether electric currents tend to its production, or whether the application of electricity can favour or prevent its growth. I have occasionally met with females who declare that cancerous swellings have been dispersed by its agency; though I myself am inclined to believe that the party who named the malady erred in judgment, and mistook for cancer some trifling induration of the mammary tissue, which occurs in young females.

SYPHILIS.

(356). The syphilitic virus consists of an abnormal organic cell, which influences the entire cell-life of the body. It appears to have no relation to the voltaic currents, nor has electricity been employed successfully for the treatment of the malady.

GLANDERS.

(357). This disease, which only occurs in man from having derived infection from a horse, consists probably of an abnormal cell, similar to that of Syphilis, and therefore of doubtful electrical relation.

CYSTS.

(358). Cysts constantly occur as a diseased production; and sometimes they contain hairs, teeth, or other matters. They appear to be a phenomenon of cell-life exclusively.

ENTOZOA AND PARASITES.

(359). The occurrence of Entozoa throughout the various parts of the animal economy, certainly presents most remarkable instances of generation. Their occurrence should cause us to weigh deeply the value of electricity in favouring the development of living creatures; for, certainly, the presence of some of these creatures is totally unaccountable upon any probable hypothesis. Some time ago, a patient of mine had a most unruly tapeworm, which would not be killed by processes amply sufficient to have destroyed abundance of other creatures of a similar class. As the patient had already received

the very best treatment from able surgeons, and had also tried every line of treatment under my care, I determined to apply electricity, with the view of destroying it. For this purpose, the current was passed from the internal parts of the anus to the surface of the stomach; and we employed as much force as the boy could possibly bear, continuing the operation for a short period on several occasions. A few joints of the worm came away subsequently; but, in my opinion, no more than what might be accounted for upon other hypotheses. This case was tried some years ago, and the to-and-fro current was employed; and, therefore, if the experiment were repeated upon a similar indestructible worm, it might be as well to use the electro-magnetic and magneto-electric machine. As this mode of employing electricity is attended with considerable pain, it would be folly to think of using it till other known modes of cure had failed. With respect to other Entozoa, or Parasites, I know no other instance where electricity has been used for their destruction.

PATHO-AISTHENICS.

(360). We have now to consider a part of the subject which is purely electro-pathological; for, inasmuch as the mechanism of all sensations is voltaic, the pathology of the same functions is voltaic also. Diseases of sensation come under our notice in all cases, where the normal reception of impressions from without is either increased, decreased, or totally prevented. They all have a somewhat similar origin, as they originate from causes emanating from the structure of the aisthenic organ itself, from a variation in the supply of blood to that organ; or from causes existing in the phreno-telegraphs, or nervous communications. Moreover, the causes may exist in the central batteries, or brain itself; and lastly, in some rare cases, the opposed pole in the peripheral battery may possibly be the source of mischief.

ANASTHESIA,

LOSS OF COMMON SENSATION.

(361). Want of feeling may arise from any of the patho-aisthenic causes already enumerated. Where the causes are organic, as in the destruction of the part itself; or of the corresponding portion of the brain; or from a division of the nerves of the part, no benefit can be expected from electricity, for it cannot restore the parts which have ceased to act. In cases where the want of feeling is simply functional (a state which is frequently found in young females about the age of puberty), the electricity may act as a stimulus, with the very best effect. It may also be employed in cases, where there is reason to believe that more or less injury has formerly occurred, but that the disease is remedied. The best form of apparatus is the electro-magnetic and magneto-electric machines; and the electricity should be used over the skin, the action of which we desire to excite, for a period varying from ten minutes to half an hour, and to such an extent that redness may be produced. In these cases, a sponge (fig. 31) may be conveniently employed for the application of the electricity.

NEURALGIA,

PAINFUL SENSATION.

(362). Neuralgia is somewhat the converse of the want of feeling, and may proceed from all the causes detailed in the paragraph on patho-aisthenics. However, causes existing at the dynamic pole, or muscle, are frequent sources of neuralgic pains; and as every sensor nerve is opposed to every dynamic nerve, neuralgic pains occasionally arise from some irritant, situated at a considerable distance from the spot exhibiting the

phenomena. In Pthisis, in a very incipient state, foreign matter exists in the lungs, which constantly causes neuralgic pains over the head, the side of the face, the back of the neck, shoulder, or over the skin of the chest. These are symptoms which I always enquire after, when I apprehend any tendency to that malady, and almost certainly find them to be present. All cases of Neuralgia are strictly patho-electric conditions; but electricity has not yet been brought to bear to any extent for their alleviation. Nervous power, however, is exhausted by the continuous voltaic current; and, therefore, I should consider that cases in which the cause of Neuralgia was local might possibly be relieved. In these instances, however, we have an infallible remedy in aconitine. Where this substance is useless, electricity perhaps would be of no benefit; and where aconitine can be employed, no surgeon would ever dream of subjecting the patient to the pain of a continuous voltaic current. In toothache, electricity both intermittent and continuous is said to be useful; and a special contrivance is sometimes employed (fig. 29) for its application.

DISEASES OF VISION.

(363). As Vision is essentially a voltaic phenomenon, diseased states do not differ from patho-aisthenics as I have already described them. Healthy vision may be prevented by the retina being veiled by some abnormal deposits, as in cataract. It may be interfered with by some altered state (congenital or acquired) of the refracting humours; and lastly, the electro-biological actions may be at fault. If too little or too much blood be supplied to the retina, or if its quality be altered, healthy vision cannot occur. If inflammation comes on, vision cannot be performed. Moreover, it is necessary to have a perfect integrity of the optic nerves to carry the sensation; and lastly, an integrity of the structures of the brain to receive them.

(364). Although all varieties in the action of vision, as partial or complete blindness, are patho-electric states in the strictest sense of the word, yet electricity should be very cautiously employed as a remedial agent. In certain instances, I have seen it of great benefit when applied to the eyebrows, skin of the forehead, eyelids, and neighbouring parts; and an instrument is sold for (fig. 28) applying it directly over the globe of the eye. The cases, however, in which it is applicable are few, because it would be useless in disorganisation of the retina, optic nerves, or brain. Nevertheless, in cases free from inflammation and disorganisation, when the surgeon desires a stimulus, it may be employed with the best of results. In certain hysterical conditions, and in certain cases of hemiopia, where the eye, from repose, seems, if I may use the term, to have forgotten how to act, its application is beneficial. Whenever electricity is employed to so delicate an organ as the eye, very feeble currents should be used. Electricity in the form of sparks from the electrical machine, or that derived from the electro-galvanic, or magneto-electric machines, may be employed. The one pole might be held in the patient's hand, whilst the other is passed over the regions intended to be stimulated.

DEAFNESS.

(365). Diseases of hearing are patho-electric states, like diseases of vision, and may arise from analogous causes. Where the malady depends upon any alterations of the structure of the organ itself, the connecting medium, or the brain, electro-therapeutic treatment must necessarily be abortive; but there are many instances where the vital actions only of hearing are at fault, as in cases of nervous deafness, and in which electricity may be applied with good effect. A contrivance is used to apply the electricity directly into the meatus (fig. 29); but perhaps it would be preferable to employ the electricity over the skin of

the face, and back of the neck, by passing one pole over those regions, and causing the patient to hold the other pole in his hand. The electro-magnetic, or magneto-electric machines are those commonly used for this purpose.

Preternatural acuteness of hearing is a very formidable symptom when it occurs in certain maladies. It is an electro-pathological state, but electricity cannot be used for its relief.

DISEASES OF SMELLING.

(366). Variations in the healthy powers of appreciating odours are electro-pathological states, and depend upon general patho-aisthenic causes before enumerated. I know of no instance in which electricity has been beneficially employed for their cure.

DISEASES OF TASTE.

(367). Taste is apt to be much impaired in derangements of the electro-biological circuit. An absence of taste, or an altered perception of taste, constantly occurs in fevers, or, in fact, in any malady having a powerful influence on the body. I remember to have seen cases where the application of extremely feeble currents might possibly have been useful; for instance, where patients have recovered from severe illness, and a total absence of taste has remained.

PATHO-DYNAMICS.

(368). In the human body, we appear to generate within our bodies but one physical force, namely, that which is produced through the medium of our muscles. For its manifestation, the muscular structure must remain intact, and a proper

amount of arterial blood must be supplied to that tissue. Moreover, the nervous communication with the central batteries must be properly maintained, an integrity of brain must exist, and lastly, the opposed pole of the peripheral battery must be in a condition to perform its functions. All diseased states of motion have their origin in these several regions; and, therefore, when we seek the cause of a patho-dynamic state, we must examine both poles of the peripheral and central batteries, the telegraphic communication between the two, and ascertain whether proper arterial blood is supplied to the entire circuit.

The diseases of motion are, first, those where motion is either increased, or where it takes place when not desired, as in tonic, clonic, and synclonic spasms. The remainder of the diseases of motion appertain to a diminished power, as alternating palsy.

TETANUS, AND OTHER TONIC SPASMS.

(369). Tetanus, or lock-jaw, exhibits itself as a violent tonic or sustained spasm. In this disease, the muscles of the anterior, of the posterior, and even sometimes of the lateral parts of the body, are thrown into the most violent spasm, causing the most agonising pain, and almost invariably ending in death. This fearful malady is a disease of motion, and therefore is essentially an electro-pathological state. It has its origin in all parts of the electro-pathological circuit, and is sometimes caused by changes in the central batteries, or brain; at other times, in the peripheral battery, or body.

(370). Mattucci has suggested the application of a constant voltaic current, for the purpose of exhausting the nervous power; but I must confess that I should myself rather rely upon general electro-therapeutic treatment, than upon the direct action of electricity itself: nor do I believe that the exhaustion of a powerful voltaic battery could possibly be applied to cure the patient. An electro-therapeutic treatment, by which we

alter the qualities of the blood, is perhaps much better adapted; and of all treatments, ether and chloroform, carried to as great an extent as the party could safely bear, and maintained over a long period, would give to the patient the best chance of success. The application of ether and chloroform would be strictly electro-therapeutic, inasmuch as the qualities of the blood would be altered, and thus the electro-biological circuit could not act in the terrible manner which it is observed to do in lock-jaw.

(371). In hydrophobia, a tonic spasm exists in the muscles of the throat and chest, which eventually kills the patient. Now we have learnt the use of ether and chloroform, perhaps they may be used to control the spasm, and save the patient's life. This malady is fortunately rare, and at present, I have neither seen nor heard of a case where it has been employed.

(372). Cramp is another instance of tonic spasm, affecting one or two muscles. It is a strictly patho-dynamic affection, and may arise from any causes acting upon any part of the electro-biological circuit, and sometimes manifests itself at great distances from the source of the mischief. Irritating or indigestible matters in the alimentary canal, frequently cause intense cramp in some of the musclar fibres of the leg, and occasion much pain and annoyance to the individual. I do not think that electricity would in all cases benefit this electro-pathological state.

COUGH, SNEEZING, HICCOUGH, ETC.

(373). Cough, sneezing, yawning, twitching, twinkling, are all varieties of clonic spasms, or irregular and sudden contraction of certain muscles. All these forms of spasm come from general patho-dynamic causes, but are chiefly referable to causes emanating in the peripheral battery. It is quite remarkable to what an extent these spasms may exist, without destroying life. Sometimes, after severe accidents, hiccough may

occur for days or weeks consecutively, and yet with careful treatment, the party may completely recover. I have not yet seen electricity employed usefully in any of these spasms, though this treatment must depend upon general electro-therapeutic principles.

ST. VITUS'S DANCE.

(374). Chorea, or St. Vitus's dance, consists of what are termed synclonic spasms, or multiplied agitation of the muscles. It is a strictly patho-dynamic affection, and appears rather to have its origin from causes emanating in the blood; for universal experience has shewn, that the administration of iron is of the utmost value, which fact probably depends upon electro-therapeutic principles. After the employment of iron, most surgeons agree upon the value of electricity. This, in my opinion, acts by breaking this spasmodic action; for it is very important that clonic and synclonic spasms should not become a habit in the system. The form of electricity which has been found by all operators to be most serviceable, is the interrupted current of the electro-magnetic and magneto-electric machine. One pole should be held in the hand, or placed at the side of the foot, whilst the other is passed over the skin of all the surrounding parts. The current should be continued from ten to thirty minutes every day, and should be as powerful as the parts can comfortably bear. Iron, quinine, and proper tonic diet, should not be omitted at the same time.

TREMBLING, FIDGETS, ETC.

(375). These states are also instances of synclonic spasms, and come from the general patho-dynamic causes already enumerated. Trembling frequently occurs from the effects of fear, which destroys the balance of action in the different parts of the body. It also arises from the action of mercury. After the

causes have been removed, electricity is of great value, as tending to break the habit, and to stimulate the parts to healthy action. In old people, the fidgets are a source of great discomfort, as they occur chiefly at night, and keep the patient perpetually awake and uneasy by the continual startings of the limbs. The malady generally arises from irritating matter in the stomach, and is best treated by tonics and attention to the alimentary canal.

ELECTRO-PATHO NOEMICS.

(376). Thus far, I have considered only the imperfections of the electro-biological circuit, which arise either from the aisthenic or dynamic pole of the peripheral battery: I shall now briefly consider the diseased states of the central batteries. In the first place, we have diseases of memory, which are manifested either in the impairment or the exaltation of this electro-vital phenomenon. Want of memory constantly occurs in epileptic cases; and in severe forms of the disease, I have seen persons who could not even remember their own name. At other times, bygone events are so firmly impressed, that they continually appear to the party; but perhaps in these cases, it is rather a strong impression than an absolute disease. Both these states are strictly electro-pathological.

IDIOTCY.

(377). Idiotcy may arise from an absence of memory, or from such imperfect organisation that the various mental phenomena cannot be evinced. It is certain, if the mental functions proceed from the organisation of the brain, that when the organisation is incomplete, the mental functions must be imperfect. Idiots frequently bear the impress of their character

in the form of the head; and a skull manifestly incompetent to contain the entire central batteries, indicates at once that the party must have a deficiency of mental power, and thus exhibit idiotcy. Sometimes, however, a perfectly-formed skull has been observed with an atrophied brain inside, in which case the individual was an idiot, without external signs.

GIDDINESS.

(378). Man only maintains the erect posture by an intricate combination of muscular movements. It continually happens, however, that the state of the central batteries is such, that the combination is not perfectly maintained. In this case, the patient feels the sensation which is termed giddiness, and may thus easily fall or be thrown down. I have lately seen a case where the central batteries were injured by excess of drink, and the party thus affected was blown down by the force of even a moderate wind. A want of supply of blood to the head, instantly produces giddiness, as will also exhaustion; and extreme cold is well known to produce this state. Giddiness is essentially an electro-pathological state, and must be treated according to electro-therapeutics. I cannot call to mind any circumstances in which electricity may be beneficially employed for its cure.

DELIRIUM.

(379). Delirium is another electro-pathological state of much importance, which has its origin, in many cases, from alteration of the qualities of the blood; in others, from exhaustion of the nervous system. Delirium is almost always seen in fevers, the patient usually becoming delirious at night; and in this case, delirium may exist for some time, without any permanent injury. Delirium tremens, or as the sailors emphatically call it "*The*

Horrors," may exhibit itself after severe nervous exhaustion, but more especially occurs in those who have lived freely. They shew, at first, a restlessness, which exhibits itself in their continually moving their hands, and which even amounts at times to a travelling propensity, and at last they sink exhausted either into sleep, or into the sleep of death. Some time since, I had to examine a patient who suddenly had a travelling fit, and who actually wandered from London, over two-thirds of the county of Kent, when at last he dropped down insensible by the road side, and was carried by some charitable individuals into a neighbouring house. Experience has shewn that, in these cases, it is necessary that the central battery should be replenished by sleep; and at present, narcotics and stimulants, separately or conjoined, are held by all good practitioners in the highest repute. There is an idea amongst many distinguished practitioners, that chloroform is likely to be beneficial in these cases; but I must confess, that for this malady, it appears to me to be a highly dangerous agent, especially for severe cases. Under these circumstances, I shall not myself employ it, unless supplied with positive evidence of its universal success. Although an electro-pathological state, delirium is not treated by electricity at the present time.

INSENSIBILITY.

(380). Whenever either a deficiency of arterial blood, or blood of vitiated quality is supplied to the sensorium, it is rendered unfit for its purpose, and the central batteries cannot act. For this reason, no impression can be received from without when a party is under the influence of carbonic acid, narcotic poisons, or any other materials which shall either alter the qualities of the blood, or prevent it from acting upon the brain. Insensibility may also arise whenever the organic structure of the central battery is deranged. Lastly, a party becomes in-

sensible when the connection between the central and peripheral batteries is destroyed. In all these instances, our treatment must be electro-therapeutic. We must, if possible, place the patient under circumstances favourable for the electro-biological circuit to act. If every requisite for action be present, then great benefit may be obtained by the stimulating properties of electricity. For this purpose, either the electro-magnetic or magneto-electric machines are constantly employed; and experience indicates that good results may be obtained by causing the electric force to act upon the muscles of the chest from the diaphragm to the spine. Electricity cannot remedy the crushed or divided spinal chord; and the instances in which it is serviceable, are only those in which the whole circuit is inactive, and requires a little stimulus to cause it again to act.

DESIRE FOR ACTION.

(381). I have already shewn that the faculty of desiring is a voltaic phenomenon, and is equivalent to tension in a voltaic battery. In some cases, we find that this desire is exceedingly depressed, the patient neither caring to move, nor to perform any function. In other instances, this desire is exalted; and I apprehend that a right consideration of this state is of the utmost importance in criminal cases. There can be no doubt, but that the desire to act often arises in young females from suppressed catamenia; and the question arises, how far they are responsible for that action. These cases open very important subjects; for if we hold the parties' irresponsibility, other parties so situated are taught that they may act with impunity; and, unquestionably, a strong moral impression might always, if present, control the faculty of desiring from doing wrong, be it ever so exalted. Where no strong moral impression exists in the higher batteries, to control each specific act, the party may be impelled to action in a manner repug-

nant to morality and laws. The state is strictly electro-pathological, and should be treated electro-therapeutically.

INSANITY.

(382). In a former part of this work, I have shewn that reasoning from the known to the unknown, upon general voltaic principles, we must admit that a variety of batteries exist in the brain, which constitute the mechanism of thought, and all other mental operations. In so complex a structure, it can be easily supposed that, from various causes, the mechanism should be often thrown out of action, which, in the operations of the mind, would be attended with extraordinary results. In the first place, we observe that the phreno-aisthenic battery, in which our knowledge is limited, is sometimes at fault. I have only recently had to examine a party, whose insanity consisted in the belief that a situation was open to him at the London Joint Stock Bank, with a salary of £300,000 per annum. Scarcely a month passes, without parties applying to the Bank of England for hundreds of millions, which they assert to be due to them. The phreno-aisthenic battery limits our knowledge; and sometimes a converse insanity to that just described exists, as when patients, having large property, fancy they are ruined, and the rich man believes he has not enough to supply his immediate wants.

(383). In the syndramic battery, we learn volume, concurrence, and relation, all of which properties are occasionally disturbed. Cases have been narrated, where a man could not be persuaded that he could go through a doorway, as his insanity caused him to believe that his volume was so great.

(384). I have lately myself had to report upon a curious case, where relation was disturbed, and the insane party thought that a gentleman was affecting the bodies of other individuals, causing a cancer in one, consumption in a second, and rheumatism in a third. Two of these parties actually died

of cancer and consumption; and the party supposed to affect them was in the same establishment. The insanity consisted in the relation of the action of this gentleman to the diseases manifested in the other individuals. Three or four years ago, the attention of the entire metropolis was occupied by an extraordinary trial of certain will-forgers, in which Fletcher, Barber, and others figured so notoriously. Shortly afterwards, I had to examine a gentleman who believed himself the object of a conspiracy, and that others intended to fix a similar forgery upon him. In this case, the circumstances of the trial were fresh in his memory, and he erred by thinking himself the object of suspicion. Here, probably, the syndramic battery was also at fault. Insanity arising from this battery, sometimes consists in the conjunction of two events happening at two different epochs, whereby they appear as one event, all the parts of which concur in the time of their occurrence.

(385). Insane persons sometimes err in their knowledge of the sense through which they are made acquainted with any fact; thus, they fancy they have seen a person of whom, in fact, they have only heard; and in the same manner the error occurs for other senses. These cases of error arise in the aisthenic-noemic and syndramic-noemic batteries.

(386). In the knowledge derived from various combinations of the central batteries, we obtain, sometimes, insane ideas. By combining a specific combination with infinity, and without at the same time limiting the combination, the insane person gives to it spiritual qualities. A gentleman, in the presence of a large number of others, fell down suddenly upon his knees before another party, and prayed that he would have mercy upon him. This second gentleman referred him at once to myself to enquire into so singular a phenomenon. On investigating the matter, it appeared that the insane man thought that the second gentleman was an angel come from heaven to punish him for his iniquities; and I found that the error consisted in the endowment of the specific man with the properties

of infinity, and not at the same time giving a limitation to him. From similar reasons, insane parties endow themselves with infinity, without limitation, and think themselves to be the Almighty. In the instances of this character which have fallen under my notice, there is manifestly more or less weakness in the central batteries, and I should feel inclined to place the source of the mischief in the phreno-aisthenic or limitation battery.

(387). Whenever there is a fixed insane thought, or thought occurring in the brain without external cause, the normal balance of the electro-biological circuit will be disturbed, and some action may ensue in consequence of the insane idea. A party fancying himself the owner of property wrongly withheld, may kill, or attempt to kill any person whose business it is to keep him from that which he thinks he ought to have. At the present time, there are two or three persons in confinement, for attempting to destroy gentlemen holding the highest official situations at the Bank of England, for not giving to the lunatics some few hundreds of millions, to which they insanely believe they are entitled.

(388). In all cases of insanity, electro-biology teaches that a sufficient control should be imposed upon the individual, to prevent any such attempt. But this control, and this confinement, should never exceed that absolutely required to prevent damage to himself, or to those around him. In the incipient stages of insanity, this control and continual watchfulness is most required, because we cannot tell to what extent the insane thought may extend. At a later stage of the malady, electro-biology clearly shews that a strong moral impression may control an insane thought; thus, a party will be kept from doing wrong by knowing that it will lead to present inconvenience to himself; or, in other words, that if the patient acted according to the manner in which his insanity led him, he would be punished.

(389). This class of unfortunates, notwithstanding all the

laws enacted in their favour, still require more attention from the legislature. Although insane, they are capable of as much enjoyment as other people, and ought to have every means of enjoyment allowed them. Unless there is a decided reason to apprehend that mischief may arise, they should have every liberty suitable to their unfortunate case. Imprisonment in madhouses, without sufficient occasion, is a very serious affair; and perhaps nothing but a specific examination of all the facts of every insane case periodically, will prevent relatives, or so-called friends, from occasionally making a traffic of the mental afflictions of rich lunatics. Insane thoughts alone should be controlled, and prevented from acting injuriously; and in all other respects they should be allowed to have every comfort, enjoyment, and pleasure which their means and their inclination can afford, and their medical treatment safely admit of.

(390). There can be no question, but that even half-mad individuals are a perfect pest to all their friends, causing them trouble and perpetual annoyance. Notwithstanding this inconvenience, the happiness of the insane individual should be considered, and no further restraint should be imposed, than what is requisite for the safety of the lives and property of themselves, or of the community. In madhouses, every mode of assuaging this heaviest affliction of humanity should be employed; and their happiness should be carefully studied on all occasions. No affliction is equal to that of insanity, and even the slightest trace of mental imbecility is distressing, such as that of repeating over and over and over again some trifling circumstance which the party has observed, but to which the mind is unable to give its proper importance.

(391). If we refer back to the structure which may be inferred to exist in the central batteries, we shall readily perceive that if the structure there developed be interfered with, the results observable in insanity must arise. The effects may arise two ways, either by an alteration in the arrangement, or

from the alteration of the qualities of the blood. It is notorious, that when the excretions of the liver and kidneys are not perfectly performed, the patient suffers what he terms the "Blue Devils," and other unpleasant thoughts. In these cases, the blood is at fault; it does not possess its normal properties, but gives rise to the same effects which a vitiated solution would in the ordinary voltaic battery.

(392). Before leaving the subject of patho-noemics, I must briefly allude to the subject of overwork, to which our great men are peculiarly liable. In former parts of this treatise, I have particularly pointed out, that for a healthy exercise of mental power, all parts of the central batteries should be used; and then, with proper sleep, a wonderful amount of work may be performed by the healthy man. When, however, the mind, day by day, week by week, month by month, and year by year, is directed to the same subject, the parts thus employed become exhausted, and a fearful state of depression is brought on. These cases are unfortunately too frequent, but should be remedied by absolute rest from the labours which have produced the mischief, and gentle employment in such other ways, and upon such other subjects as shall properly exercise the other portions of the central batteries. All monotonous labour, long continued, is very hurtful to the central batteries, and should be, as far as possible, avoided. Where the central batteries are injured, the peripheral also suffer; hence the person over-worked in mind suffers also in bodily strength.

(393). There are even other pathological states of the action of the brain, besides those already described, such as reverie, absence of mind, sleep-walking, and sleep-talking. In these instances, part of the brain is active, whilst other parts are passive. In some instances, these states amount to positive disease.

FITS.

(394). Having now considered the diseases which appertain to each respective part of the electro-biological circuit, we have

next to study pathological states, dependant upon the aberration of its acting as a whole. When action is impeded, an interval occurs, in which we cannot appreciate the influence of external forces; nor can we voluntarily originate any motions. This interval of consciousness we term a "Fit," which, literally in its truest sense, marks nothing more nor less than an interval.

EPILEPSY.

(395). Of fits, perhaps the most remarkable is that of Epilepsy. In this malady, the interval of consciousness is not complete, there being no sensation or voluntary motion of any kind. Conjoined with this interval, however, involuntary spasms of a tonic and clonic character of the most violent kinds frequently occur, during which the patient bites his tongue, and inflicts other damage upon himself. Epilepsy is strictly a disease of the actions of the electro-biological circuit, and has its causes either in the central or peripheral batteries; or perhaps even occasionally in the blood itself. Before the fit, in some cases, a peculiar sensation is felt in some part of the body; and in such instances, the fit may often be stopped by cutting off the supply of blood to that part. In other cases, the patient feels consciousness gradually leaving him. I have now a patient who, before the fit occurs, feels extreme pain in one hand; and I have found that by compressing the radial and ulmar arteries, the pain is stopped, and the fit for some time is warded off. The fit is an electro-pathological state; and we must therefore look to electro-therapeutic treatment to remedy the disease. In atonic states, iron is of singular value; and I have also found that in strumous habits cod-liver oil is, in certain instances, of great utility. Epilepsy may occur from the presence of irritating matter or worms in the alimentary canal. and then may be cured by getting rid of the peccant matter. When

Epilepsy is consequent upon organic alteration in the central batteries, no treatment is likely to be effectual. I do not think that electricity can often be beneficially employed for Epilepsy.

COMA.

(396). Comatose fits arise from the action of the central batteries being interfered with, and are seen in apoplexy, effusion of serum in the brain, or pressure upon that organ from the skull itself. In all comatose fits, the mischief is thought to reside in the central batteries, and depends either upon the parenchyna being injured; or upon blood, deficient in quantity, or of an improper character, being supplied to it. Coma is a strictly electro-pathological state, and where the fit has progressed to such a state that the party breathes badly, then electricity may be beneficially employed to stimulate the chest, otherwise it would in all probability be useless.

FAINTING FITS.

(397). In Fainting Fits, the electro-biological circuit cannot act for want of a proper supply of the exciting fluid, or bright arterial blood to the central and peripheral batteries. It is therefore an electro-pathological state, and must be treated upon general electro-therapeutic principles. In certain cases, we can only save the patient's life by the transfusion of blood from another individual. In some cases, I can conceive it possible, that electricity might be employed beneficially to rouse the patient, though I myself have never had occasion to employ it.

HYSTERIA.

(398). Hysteria is a very remarkable aberration of the electro-biological circuit; for in this malady, every action of the body may be either increased or decreased. Sometimes it exhibits itself as an impairment of sensation, the patient being unable to feel, see, taste, smell, or hear. At other times, these sensations are preternaturally exalted. Again, the dynamic pole of the peripheral battery is in like manner sometimes influenced, there being a loss of power; whilst, at others, that power is exalted. The central batteries are as much the subject of this disease as the peripheral; and extensive impairments of function, or excess of action, may be observed in different cases. In Hysteria, moreover, many of the functions of the body are influenced, such as those of the skin, kidneys, and the alimentary canal, shewing their obedience, in some degree, either primarily or secondarily, to the electro-biological circuit. The treatment of Hysteria must always depend upon electro-therapeutic principles. At one time, the disease may be controlled by moral impressions influencing the higher batteries; at other times, heat and cold can be advantageously employed; and, in the whole range of pathology, no disease requires more care for its diagnosis, or skill for its treatment, as the circumstances of each particular case differ; and the treatment must be entirely regulated by the circumstances. In certain instances, electricity might be used advantageously in hysterical affections.

COLLAPSE.

(399). When any violent impression is made on the electro-biological circuit, its action is depressed, and the patient is said to be in the state of collapse. This state is caused by a shock to the system, which may be either psychological, influencing

the entire system from its action on the higher batteries, and thus influencing the entire circuit; or physical, by an extensive injury to the body, such as by crushing, tearing, burning, or by the destruction of any large extent of the peripheral battery. Persons frequently instantly die under the influence of strong moral emotions, as those of joy or grief; from this cause, collapse is then an electro-pathological state produced by the excessive exhaustion of a powerful action on the electro-biological circuit; and the treatment must be directed to the renovation of the powers of the system. States of collapse, where the patient is hovering between life and death, are perfectly frightful. In these instances, the surgeon can only save his patient by incessant care, watchfulness, and exertion; and it is truly one of the delights which the medical profession is alone permitted to enjoy, to see the apparently dying man regain his exhausted power, and be restored to his family by care and attention. I have never used electricity for collapse, though it is possible that in some cases it might be advantageously employed.

INDIGESTION.

(400). It has been abundantly shewn by Wilson Phillips, and other experimenters, that digestion is influenced by nervous action. In fact, we all know that the process of digestion is iustantly stopped by strong moral emotions, and does not take place freely when the electro-biological circuit is much exhausted or tired. A considerable amount of power is required for digestion itself; and when that power is depressed from any circumstance, digestion does not perfectly take place. Now, a question naturally arises upon this subject; for if indigestion is an electro-pathological phenomenon, dependent upon absence of electro-nervous power, we might infer that electricity might artificially supply the desideratum and get rid of the affection. Electro-Biology answers that, in all probability,

such would be the case, and that the artificial employment of electricity would compensate its natural want. It is a very important element in the matter, that the electricity should be employed in the same way that it naturally acts in the body; and I have no hesitation in stating, that although I have given the subject the most careful consideration, I am compelled to come to the conclusion, that I know no mode of applying electricity to supply the defect: that is to say, I do not think it possible to apply electricity in the same way that the nervous power acts.

(401). It is right, however, to state that some observers have believed that they have derived benefit by the use of electricity; and if any person is desirous to try it, I would recommend the intermittent current of the electro-magnetic and magneto-electric machines to be passed from the back of the neck, to the pit of the stomach, the operator keeping the poles moving over large tracts of cutaneous tissues. For myself, I have but little confidence in it.

AMENORRHŒA.

(402). In a former chapter, I have detailed the remarkable effect which electricity has upon the motion of the blood in the capillaries; and thus it is ascertained that it must influence all actions which immediately depend upon the circulation of the blood. In Amenorrhœa, we may assume that the uterus is not perfectly supplied with blood, to perform the normal functions; and in these cases, electricity comes to our aid with the best possible effect. Of course, if the female is in a state of bloodlessness, it would be in vain to expect her to give off blood, or blood-like materials. In consequence of this, the general powers of the patient must first be regarded; and the use of iron, in all its forms, has the sanction of the experience of every medical man, as an invaluable remedy in these cases.

(403). When, however, the practitioner thinks that the patient is competent to excrete the catamenial fluid, he may apply electricity with the best result. He should apply it to those parts where abnormal sensations are felt in disordered states. In these instances, the inside of the thigh, the loins, and the bottom of the stomach are the snbject of uneasy sensations; and over these regions the operator should employ the poles of the electrical apparatus, and move them about, to cause a large extent of surface to be acted upon by the electrical power. Under this treatment it will frequently return. We occasionally perceive cases, in which the suppression of this function is attended with much constitutional disturbance, such as the continual recurrence of hysterical fits. In these cases, it is sometimes of importance to cause the secretion to take place with the least possible delay, when the electricity should be applied to the uterus itself, by introducing a Radford's conductor (fig. 27), or any similar contrivance, into the vagina, that it may actually come in contact with that organ. The opposite pole should be moved over the lower part of the stomach, the surface of the thighs, the loins, and surrounding parts. The amount of electricity must not exceed that which the patient can comfortably bear, which, in this instance, is but slight. The current from the electro-magnetic or magneto-electric machines, is best adapted for this purpose, and forms a very valuable adjunct to other remedial measures.

BARRENNESS.

(404). The same reasons for which electricity is rendered valuable in amenorrhœa, might lead us to expect that it would tend to rectify this state in the female; for, by causing it directly to act upon the uterus, it is calculated to increase the supply of blood, and thus remedy the defect.

UTERINE INERTIA.

(405). The uterus being a muscular structure, and electricity causing pre-eminently muscular contraction, it may be expected, that to cause uterine contraction, electricity would be the best stimulus. Cases have been published where it has been used for this purpose, though it should be borne in mind that electricity does not stimulate involuntary muscles to the extent to which it acts upon the voluntary muscles. Upon this matter, I cannot write from my own knowledge; and although I conceive the remedy to be worth an extensive trial, I am afraid that it will not be found so beneficial as at first sight appears.

(406). The observations which have been made on uterine inertia, apply also to uterine bleeding, which occurs from the mouths of the vessels not being sufficiently closed after parturition. A far greater number of observations are required to establish its benefit, than has at present been made. Dr. Radford has proposed its use for these purposes, and has contrived a director for its application (fig. 29).

ASTHMA.

(407). Asthma arises from such various causes, that it will be out of place in the present volume to consider it in detail. There are certain instances, however, in which benefit may be derived from the application of electricity to the chest. In this instance, the muscles of respiration should as far as possible be brought into play, and the electricity should be continued till the skin of the surface is reddened. I need hardly state that electricity will be valueless, if organic changes have been the cause of the asthma, as it is only calculated to be eminently useful in functional derangements. The electricity which is preferable, is that derived from the electro-magnetic and mag-

neto-electric machines. It should be used to as great an extent as the patient can comfortably bear.

ASPHYXIA.

(408). A person suffers from asphyxia whenever he is cut off from the oxygen contained in the atmospheric air, or when he breathes other gases, as those of hydrogen, carbonic acid, etc. In these cases, the blood becomes vitiated, and ceases to excite either the central or peripheral batteries. Asphyxia, or as my distinguished teacher, Dr. Watson, more properly called it, apnœa, is a strictly electro-pathological state. Now electricity alone cannot remedy such a condition, though, in certain instances, it may be most advantageously employed. When, for instance, a stimulus to the muscles of the chest is required, it may be advantageously employed; as, for instance, after poisoning by opium, drowning, and other similar cases. Electricity should, however, only be regarded as an adjuvant, and not at all comparable to the value of the action of oxygen upon the system. For this reason, electricity should never be employed to the exclusion of other remedies, though as an assistant, it deserves a prominent place. The value of electricity in these cases is extensively admitted by medical men.

ABNORMAL STATES OF SECRETION AND EXCRETION.

(409). It is still unknown to what extent secretion and excretion are influenced by the electro-biological circuit, and consequently the relation in a state of disease is equally obscure. The kidneys excrete more urine, and urine of a different character in certain states of nervous excitement; but this does not prove that its action is immediately dependant upon nervous influence, because, in this state of the system, the blood may be altered, and thus secondarily influence the kidneys. I have

heard of cases where electricity has been employed with the view of stimulating these organs, but I really do not pretend to know in what manner a current of electricity can be made to pass through them.

(410). The observations made upon the functions of the kidneys apply also to that of the liver, though I believe it is still less under the action of electricity evolved in the electro-biological circuit; and I know of no mode by which a current of electricity may be made effectually to act upon that organ. The alimentary canal is much more under the action of the electro-biological circuit than either the kidneys or liver. All abnormal states of the alimentary canal affect this circuit, and, conversely, all abnormal states of this circuit affect the alimentary canal. I have seen individuals on whom the application of electricity always acts as an aperient, though it is not commonly used for that purpose. In certain instances, where the intestinal canal is distended with gas, electricity would act as a fair stimulus.

(411). I have heard that electricity has been advantageously employed at the Free Hospital, to rally a patient in the collapsed stage of cholera, — a fact which I mention here, as this disease involves, to a great extent, the functions of the alimentary canal.

(412). The functions of the skin appear to be influenced by nervous action; a person in great fear will break out into a profuse perspiration. The older electricians believed that the ordinary electrical machines would cause a copious exhalation, but electricity is not now employed for that purpose.

(413). If we now take a review of the cases in which electricity is beneficial, we perceive that it is useful in two classes of cases; those in which the circulation of the blood through the capillaries is sought to be influenced, and those in which the nervous actions are sought to be acted upon. In every instance where electricity is employed, we have also in almost every case, other means which may be used to attain the same end. The value

of electricity, as compared with other remedies, must then depend simply upon the comparative facility with which the end is accomplished; and the question of its application resolves itself into a question of time, convenience, and perfection.

Before I terminate this chapter, I think that it will be highly interesting to my readers, to quote an account which has been given of the first shock which was received by any investigator, and the account certainly shews the astonishment which followed the sensation:—

"The end of the year 1745, and the beginning of 1746, were famous for the discovery of the accumulation of electricity on glass, called the *Leyden Phial*, so called, because the experiment was made by Mr. Cuneus, a native of Leyden; but the person who made the discovery was Mr. Von Kleest, dean of Cammin. On the 4th of November, 1745, the first shock was felt by this gentleman. He says, when a nail or piece of thick brass wire is put into an apothecary's small phial, and electrified, remarkable effects follow. Mr. Muschenbroek tried the experiment with a very thin glass bowl, and says, in a letter to Mr. Reaumur, that he felt himself struck in his arms, shoulder, and breast, so that he lost his breath, and was two days before he recovered from the effects of the blow and terror, and that he would not take a second shock for the kingdom of France. Various accounts are given of the effects of the shock; the most remarkable is that of Mr. Winckle of Leipsic. He says, that the first time he tried the Leyden experiment, he found great convulsions in his body from it, that it put his blood into such great agitation, that he was afraid of an ardent fever, and was obliged to use refrigerating medicines; he felt a heaviness in his head, as if a stone lay upon it; twice it gave him a bleeding at his nose. His wife had the courage to take two shocks, and found herself so weak that she could hardly walk. A week after, she received another shock, when she bled at the nose."

CONCLUSION.

Throughout this treatise, I have felt, in every department, my inability to do justice to the subject, which I have found to be far beyond my powers, either of physical capabilities to observe, or of mind to appreciate. Nevertheless, every step which I took, indicated more clearly that a work of this character, however imperfect, was required by investigators of science. In attempting to detail my experiments upon the subject, and in pretending to offer my own thoughts upon those experiments to the world, I felt that I should perhaps justly incur the censure of some individuals. My object, however, has been to endeavour to incite others who may have more leisure, greater capability, and higher mental endowments than myself, to follow this investigation.

In submitting this work to the Public, I may state that its development has afforded to me unmixed delight; and with respect to the opinion which other philosophers, after due deliberation, may be led to form of its contents, I can only say, in the words of the immortal Harvey, "*Spes mea in amore veritatis et dictorum animorum candore.*"

Bayerische
St

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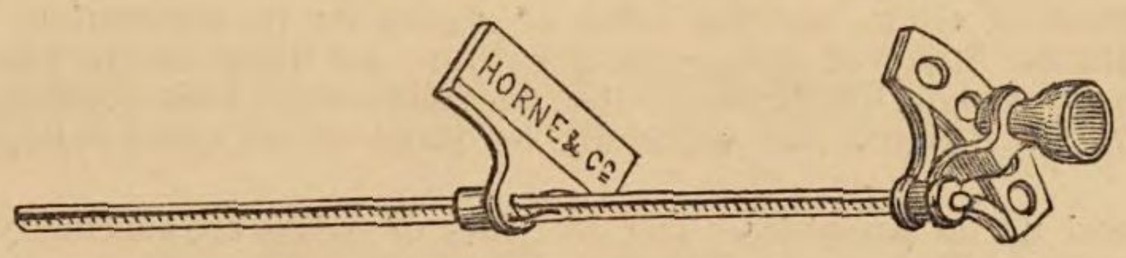

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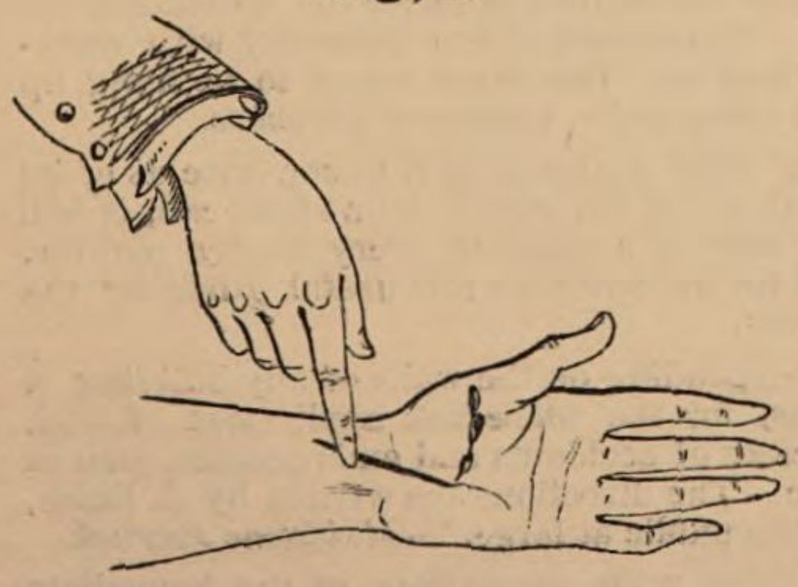
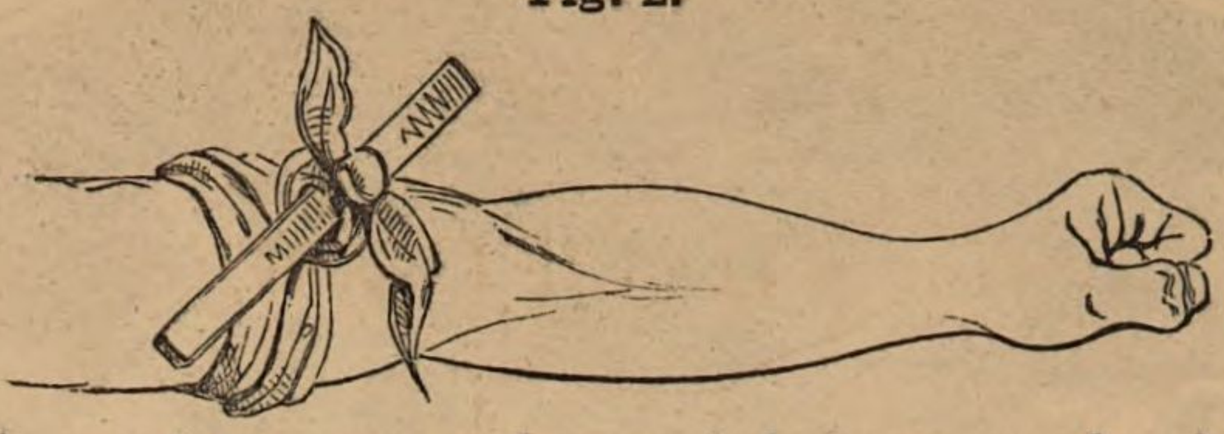


Arterial bleeding is known from the bright scarlet colour of the blood, and from its issuing in jerks. To stop it, put your finger in the wound and press upon the bleeding aperture, and as long as this pressure is properly applied, bleeding cannot occur (Fig. 1). Or, tie a handkerchief twice round the limb, above the injury, and place a piece of stick in it, and and turn till the pressure is so great that

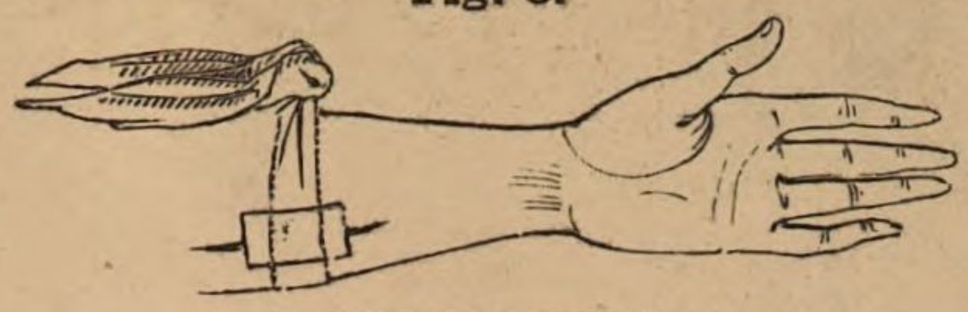
the blood cannot flow (Fig. 2). Or, fold a piece of soft rag several times, and

Fig. 2.



put it quickly over the aperture, and secure it in its proper place by a piece of broad tape, or a bandage (Fig. 3).

Fig. 3.



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THE VOLTAIC MECHANISM OF MAN;

OF

ELECTRO-PATHOLOGY,

ESPECIALLY OF THE NERVOUS SYSTEM;

AND OF

ELECTRO-THERAPEUTICS.

BY

ALFRED SMEE, F.R.S.

SURGEON TO THE BANK OF ENGLAND; TO THE CENTRAL LONDON OPHTHALMIC HOSPITAL;
TO THE ROYAL GENERAL DISPENSARY, ETC. ETC. ETC.

Illustrated with numerous Engravings on Wood.

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PATERNOSTER ROW;
AND
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123, NEWGATE STREET.

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WERTHEIMER AND CO., CIRCUS PLACE, FINSBURY CIRCUS.

A CONDENSED CATALOGUE

OF

CHEMICAL AND OTHER APPARATUS,

FOR ILLUSTRATING THE VARIOUS BRANCHES OF

NATURAL PHILOSOPHY;

MANUFACTURED AND SOLD BY

HORNE, THORNTHWAITE, AND WOOD,

Opticians, and Philosophical Instrument Makers to the Hon. Corporation of the City of London Schools, British and Foreign School Society, &c., &c.

123, NEWGATE STREET, LONDON.

CHEMICAL APPARATUS.

		s.	d.		£	s.	d.
Alembics, Glass, ¼ pint to 2 qts.		5	0	to	1	0	0
Alembics, Earthen	from	3	0				
Argand Lamps	each	6	0		0	8	0
Ditto ditto, with double Concentric Wick					0	15	0
Alkalimeters	each				0	6	0
Boxes of Fragments for the Blowpipe	per set				0	2	0
Bladder, with Ferrule		2	0	to	0	3	0
Ditto, with Stop Cock		5	0	to	0	6	6
Bars of Copper, Zinc, and Iron	from	0	6				
Brass Tripod Stands					0	1	6
Black Lead and Porcelain Tubes for Furnaces	from	1	0				
Bent Tubes of every description made to order							
Brass Pipe for blowing Gas Bubbles					0	2	6
Blowpipes, common	from	0	6				
Ditto, Pepy's		6	0				
Ditto, Wollaston's		6	0				
Ditto, Black's	from	1	0		0	2	6
Ditto, Bergman's		5	0				
Ditto, Gurney's Oxy-Hydrogen					2	2	0
Ditto, Self-Acting Spirit, Brass					1	10	0
Ditto, ditto, Tin		6	0				
Ditto, Bellows, with Table, &c.	from	63	0		6	6	0
Ditto, Hemming's Jet					0	9	0
Ditto, Tilley's Hydraulic		21	0	o	1	5	0
Ditto, ditto, very superior					2	2	0
Balloons	each from	1	6		0	10	0

Philosophical Apparatus, &c., sold by HORNE, THORNTHWAITE, & WOOD, 123, *Newgate Street, London.*

	s.	d.		£	s.	d.
Bell Air Jars, Glass, with ground stoppers, for collecting the gases	3	3	each 2s. 6d.,	0	4	0
Ditto ditto, mounted with Brass Caps and Screws, for the reception of Air Cocks and other Apparatus, each, pints 4s., quarts, 5s.	3	6	from	0	8	6
Ditto, graduated				0	10	0
Cut Air Jars, per nest of 6				0	3	0
Ditto ditto, larger	0	6	each	to 0	1	0
Crucibles, Cast Iron	0	3	in nests			
Ditto, Hessian and English	5	6	from			
Chemical Scales	63	0	from			
Ditto ditto, with Decimal Weights	12	0	each from			
Chafing Dishes	1	6	from			
Crucible Tongs	4	0	per lb.	to 0	12	0
Covered Copper Wire	1	9	from			
Copper Basins	2	0	from			
Copper Sand Baths	7	0	from			
Iron ditto			each	0	5	0
Cubic Inch Tubes	1	0	each			
Caoutchouc, in sheets	1	6	per ft. from			
Ditto Tubing	0	4	per oz.			
Ditto Varnish			from	5	5	0
Copper Stills, with Furnace, Tub, &c., complete	5	6		to 0	6	6
Cuff's Scale of Chemical Equivalents				0	2	0
Cement for attaching Brass Work to Glass Apparatus			per lb.	0	4	0
Cryophorus			each			
Bottles, stoppered, of all dimensions.						
Ditto ditto, with Glass Caps, for Acids, Volatile Fluids, &c.	2	0	from			
Ditto, Woulfe's	2	6	each pint	qt. 0	3	6
Ditto, Specific Gravity			each	0	1	6
Ditto, Specific Gravity, stopped, and graduated to 1000 grains, in Tin Case, with Counterpoise Weight				0	8	6
Connecting Pieces and Ferrules, Brass			each	0	0	10
Candle Bombs			per doz.	0	0	4
Decimal Weights, complete set of, in Mahogany Box				1	10	0
Deflagrating Ladles			each	0	0	6
Deflagrating Ladle and Air-tight Collar	2	6		0	3	6
Davy's Safety Lamp			each	0	10	6
Dropping Tubes	0	4		0	0	6
Elegant and very useful Apparatus, for Experiments with the mixed Gases upon Lime				1	0	0
Eudiometers, Ure's				0	8	6

Evaporating Dishes of real Wedgwood-ware, not liable to crack or stain—

	s.	d.		s.	d.
2 inch over	0	4	7 inch over	1	8
3 ditto	0	6	8 ditto	2	0
4 ditto	0	9	9 ditto	2	6
5 ditto	1	0	10 ditto	3	6
6 ditto	1	4	11 ditto	4	0
			12 ditto	5	0

each

Flasks, ¼ pint	0	5			
Ditto, ½ pint	0	9			
Ditto, pint	0	10			
Ditto, quart	1	3			
Ditto, with bent Tubes for generating Gases	5	0	to	0	8	6
Filtering Paper			per lb.	0	1	4
Funnels, Glass and Porcelain	0	6	from			
Ditto, long-necked, bent Glass	2	0	to	0	3	6
Furnaces, Black Lead	10	6	to	3	3	0
Ditto, French	21	0	to	1	10	0
Ditto, Horne and Co's improved Portable, combining the ordinary Chemical Furnace, with the Reverberatory and Blast, complete, with Sand-bath, &c.	£6	6	from	12	12	0
Ditto, Round				3	3	0
Ditto, Dr. Black's				4	15	0

		s.	d.		£	s.	d.
Furnace Stoves, for experimental purposes, made to order.							
Fire-clay and Lutes	per lb.	0	6				
Glass and Enamel Rods	from	0	3				
Glass Tubing	per lb. from	2	4		0	3	6
Ditto, Green, free from lead		3	6				
Gauge for showing the expansion of metals by heat					0	5	0
Hydrogen Lamps	21s.,	30	0		2	2	0
Hope's Eudiometer					0	10	6
High Pressure Boiler and Stand, with Barometer Tube, Thermometer, and Lamp, complete					3	3	0
Horizontal Revolving Jet, for exhibiting Philosophical Fire-works with Hydrogen Gas		7	0				
Hydrometers	from	7	0				
Lactometers, for ascertaining the relative value of Milk	per set				0	14	0
Mortars, Agate	from	5	0	to	2	2	0
Ditto, Iron		1	9				
Ditto, Composition—No. 0000					0	1	3
„ „ 000					0	1	6
„ „ 00					0	2	0
„ „ 0					0	2	3
„ „ 1					0	2	6
„ „ 2					0	3	0
Ditto, Glass	from				0	2	0
Muffles, Earthenware	„	0	6				
Mercurial Troughs, Mahogany	„	6	0				
Ditto ditto Iron	„	6	0				
Models of Crystals, in Wood	per set				0	7	6
Ditto ditto, in Glass	„				0	18	0
Measure Glasses, from 1 oz. to 20		1	6	to	0	4	0
One gallon Tin Still, with Worm and Tub complete		21	0		1	5	0
Ditto Copper ditto ditto					2	2	0
Ditto ditto ditto, with Iron Furnace					4	4	0
Pneumatic Troughs of various sizes	4s. 6d.,	10	6		0	16	0
Pepy's Improved Gas Holder, which, with the addition of a Jet, forms a most convenient Hydraulic Blowpipe	30s., 42s.,	52	6		3	3	0
Ditto small Balneo, or Filter Bath, for drying precipitates or explosive compounds, at a heat not exceeding 212° Far.					0	10	0
Plates of Glass for covering Air Jars		0	6	to	0	2	6
Precipitating Glasses, ¼ pint					0	0	9
Ditto ditto, ½ pint					0	1	0
Palmer's Oxy-Hydrogen Jet	each				1	1	0
Ditto, with Bladders, &c.					2	2	0
Platinum Spoons	from	1	6		1	0	0
Ditto Forceps	from	3	0				
Pulse Tubes	each				0	1	3
Retorts, Earthenware							
Ditto ditto Tubulated							
Ditto, Cast Iron, with connecting Tube for the production of Oxygen and other Gases	each				0	10	0
Retort Stands, Iron, with 3 sliding Rings	from	4	6	to	0	7	6
Ditto ditto Brass, ditto		8	0		0	14	0
Reflectors, for experiments on Radiant Heat					2	2	0

Retorts, best glass:—

2 ounces, plain	£0	0	5	Stoppered or Tubulated	0	1	0
4 ditto	0	0	6	ditto	0	1	4
8 ditto	0	0	9	ditto	0	1	8
Pint	0	1	0	ditto	0	2	0
Quart	0	2	0	ditto	0	3	9
3 pint	0	2	6	ditto	0	4	9
2 quart	0	3	0	ditto	0	5	3
1 gallon	0	3	6	ditto	0	6	6
2 ditto	0	4	6	ditto	0	9	0
3 ditto	0	5	6	ditto	0	11	0
4 ditto	0	7	6	ditto	0	15	0

	£	s.	d.		s.	d.	£	s.	d.
Receivers, glass :—									
¼-pint, plain	0	0	8	Tubulated			0	1	2
½ ditto	0	0	9	ditto			0	1	3
Pint	0	1	0	ditto			0	1	6
Quart	0	1	9	ditto			0	2	6
3 Pint	0	2	6	ditto			0	3	9
2 Quart	0	3	6	ditto			0	4	9
Ditto quilled, ¼ pint, 1*s.* 6*d.*—½ pint, 1*s.* 9*d.*—pint, 2*s.* 6*d.*									
Spirit Lamps, Glass					2s,. 3s.,	4 0	0	5	0
Ditto Brass							0	7	0
Ditto with Concentric Wick and double Current of Air, on Professor Rose's principle, mounted on a Stand							0	18	0
Thornthwaite's Analysis Lamp							2	2	0
Stills, Working Models of					30	0	2	2	0
Syphons, Glass							0	2	6
Ditto Pewter and Copper, with Stop Cock				from	7	0			
Stop Cocks, Brass				each			0	3	0
Small Iron Wire, for combustion in Oxygen Gas									
Steel Crushing Mortars and Pestles				each			0	14	0
Thermometers				from	4	6			
Ditto Chemical				from	15	0			
Test Glasses—									
1½ oz.				per doz.			0	7	0
3 oz.							0	8	0
5 oz.							0	9	0
7 oz.							0	10	0
Test Tubes				per doz.	2	0 to	0	3	6
Ditto Stands				from	1	0			
Test-tube Holders							0	0	6
Tube Retorts					0	6 to	0	0	10
Tubes, Earthenware				from	0	9			
Test Papers of Litmus and Turmeric				each	0	1			
Woulff's Apparatus of three bottles, with three necks each, mounted with Conducting and Safety Tubes, in a Mahogany Tray, pints					16	0			
Ditto ditto				quarts	20	0			
Water Hammers				each	4	0			
Welter's Tube of Safety							0	2	0
Watch-glass Holders							0	0	6

CHEMICAL CABINETS,

consisting of small assortments of Chemicals and Apparatus packed in case, for exemplifying the first principles of Chemistry, 10*s.* 6*d.*, 21*s.*, 42*s.*, and 63*s.*; if of larger size, from £5 5*s.* to £21. and upwards.

ANALYSIS CHESTS,

for Testing Minerals or general Analysis, complete, from £10 10*s.* to £50.

ASSORTMENTS OF CHEMICAL APPARATUS,

for performing the chief Chemical Experiments, £3 3*s.*, £5 5*s.*, £10 10*s.*, £20, and upwards. These assortments are packed in ordinary packing-cases, and can be recommended as preferable to chemical-chests, except in those cases where portability is of some moment. For a detailed list of the articles in each set, see General Catalogue.

CHEMICALS,

perfectly pure, for Analysis and other purposes, in sets, from 21*s.* to £10 10*s.*, or, singly, in any quantity that may be required for the Arts or Manufactures. See complete list, with prices, in General Catalogue.

	s.	d.			s.	d.	
Acid, Acetic	0	2	oz.	Acid, Benzoic	3	0	oz.
„ „ Strongest	1	0	„	„ Boracic	1	0	„
„ Arsenious	0	3	„	„ Citric	1	0	„
„ Arsenic	1	0	„	„ Fluo Silicic	0	6	„

	s.	d.	
Acid, Gallic	5	0	oz.
„ Hydriodic Sol.	1	6	„
„ Muriatic, Common	0	3	lb.
„ „ Pure	0	2	oz.
„ Nitrous	1	4	lb.
„ Nitric	1	4	„
„ „ Pure	0	4	oz.
„ Nitro Muriatic	0	4	„
„ Oxalic, Common	0	3	„
„ „ Pure	0	6	„
„ Phosphoric, Sol.	1	3	„
„ „ Glacial	1	6	„
„ Pyroligneous	1	0	lb.
„ Succinic	5	0	oz.
„ Sulphuric, Common	0	3	lb.
„ „ Pure	0	2	oz.
„ Tartaric, Common	0	3	„
„ „ Pure	0	6	„
Alloys, various.			
Æther, Acetic	1	0	oz.
„ Pyroligneous, imp. pt.	1	6	
„ Sulphuric	0	6	„
„ „ Rectified	0	9	„
„ Nitric	0	8	„
Alumine	1	6	oz.
„ Acetate, Sol.	0	4	„
Amber	0	6	„
Ammonia, Solution	0	2	„
„ Strong	0	3	„
„ Carbonate, Pure	0	3	„
„ Hydro Sulph. Sol.	0	6	„
„ Muriate	0	2	„
„ „ Pure	0	6	„
„ Nitrate	5	4	lb.
„ Oxalate	1	0	oz.
„ Phosphate	0	8	„
„ Sulphate	0	3	„
„ Succinate	8	0	„
Antimony	0	3	„
„ Glass	0	3	„
„ Nitro Muriate, Sol.	0	2	„
„ Oxides	1	0	„
„ Sulphuret	0	8	lb.
Archil	0	2	oz.
Arsenic	0	6	„
„ Sulphurets	0	4	„
Baryta	2	6	„
„ Crystals	0	3	„
„ Carbonate	0	4	„
„ „ Native	0	4	lb.
„ Chlorate	2	6	oz.
„ Muriate	0	6	„
„ Nitrate	0	6	„
„ Sulphate	0	4	„
Barytic Water	0	6	„
Bismuth	0	3	„
„ Oxide	1	0	„
„ Nitrate	1	6	„
„ Nitrate Solution	0	6	„
Borax	0	2	„
Bromine			
Cadmium	2	0	dm.
„ Oxides	2	0	„
Calcium, Chloride, Fused	1	0	oz.
Calcium, Sulphuret	0	4	oz.
Carbon, Sulphuret	1	0	„
Charcoal, Animal	0	3	„
„ Boxwood	0	6	„
Copper, Granulated	3	0	lb.
„ Acetate	1	0	oz.
Copper Carbonate	0	6	„
„ Foil	0	3	„
„ Leaf	0	2	bk.
„ Muriate	0	6	oz.
„ Nitrate	0	3	„
„ Oxides	1	6	„
„ Sulphate, Common	0	6	lb.
„ „ Pure	0	3	oz.
„ Sulphuret	0	6	„
„ Turnings	3	0	lb.
Cobalt	10	0	oz.
„ Acetate, Solution	1	0	„
„ Muriate, Solution	1	0	„
„ Oxide, Common	5	0	„
„ „ Pure	10	0	„
Fluor, Spar	0	8	lb.
Flux, Black	0	6	oz.
„ White	0	6	„
Galls	0	2	„
„ Tincture	0	3	„
Gold Chloride, Solution	5	0	„
„ Leaf	1	9	bk.
Iodine			
Iron, Acetate	0	4	oz.
„ Carbonate	1	0	lb.
„ Chromate	0	6	„
„ Filings	0	6	„
„ Muriate	0	6	oz.
„ Nitrate, Solution	0	3	„
„ Oxides	0	6	„
„ Sulphate	0	2	„
„ Sulphuret	0	8	lb.
„ Turnings	0	6	„
Lead	0	2	oz.
„ Acetate	0	2	„
„ Bin Acetate, Pure	0	6	„
„ Carbonate	0	2	„
„ Chromate	0	6	„
„ Granulated	1	6	lb.
„ Nitrate	0	6	oz.
„ Oxides			
„ Tartrate	0	6	„
Lime, Carbonate	0	1	„
„ Chloride	0	8	lb.
„ Fluate	0	8	„
Lime, Muriate, Crystals	0	6	oz.
„ „ Fused	1	0	„
„ Phosphate	0	3	„
Lime, Phosphuret	1	0	„
Litmus	0	6	„
„ Tincture	0	3	„
Lycopodium	0	6	„
Magnesia	0	8	„
„ Carbonate	0	4	„
„ Sulphate	0	1	„
Manganese, Oxides, Black	0	3	lb.
„ „ Grain	0	3	„
Mercury, Chloride	0	6	oz.

Philosophical Apparatus, &c., sold by HORNE, THORNTHWAITE, & WOOD, 123, *Newgate Street, London.*

	s.	d.	
Mercury, Bi-Chloride	0	6	oz.
„ Nitrate	0	6	„
„ Oxides	1	0	„
Naptha, Rectified	2	0	„
Nickel, Common	0	3	„
„ Sulphate	1	0	„
Phosphorus	0	9	„
Platinum, Balls	1	0	ea.
„ Chloride, Sol.	2	0	oz.
„ Native			
„ Sponge			
Platinum			
Potassium	0	1	gr.
Potash, Fused	0	6	oz.
„ Pure	2	0	„
„ Carbonate	0	9	lb.
Potash, Carbonate Pure	0	6	oz.
„ Bi-Carbonate			
„ Chlorate	0	4	„
„ Chromate	0	6	„
„ Bi-Chromate	0	6	„
„ Hydriodate			
„ Nitrate, Pure	0	3	„
„ Prussiate	0	3	„
„ „ Pure	0	6	„
Selenium	0	4	gr.

	s.	d.	
Silex	1	0	oz.
Sodium	0	1	gr.
Soda, Carbonate	0	3	oz.
„ Bi-Carbonate	0	3	„
Strontia	2	0	„
„ Crystals	2	0	„
„ Muriate	0	6	„
„ Nitrate	0	2	„
Silver, Leaf	1	6	bk.
„ Nitrate	5	0	oz.
„ „ Fused	5	0	„
Sulphur, Roll	0	4	lb.
„ Sublimed	0	6	„
Tin	0	3	oz.
„ Foil	0	3	„
„ Granulated	0	3	„
Test Papers, Brazil Wood	0	1	sht.
„ Litmus	0	1	„
„ „ Red	0	1	„
„ „ Red Cabbage	0	1	„
„ „ Turmeric	0	1	„
Zinc	0	4	lb.
„ Foil	0	3	oz.
„ Granulated	0	8	lb.
„ Malleable Sheet	0	8	„
„ Sulphate	0	3	oz.

TOXICOLOGICAL APPARATUS,

complete with Chemicals in Chests, as described by Christisom, Thompson, Marsh, Reinsch, &c., &c., £3 3*s*., £5 5*s*., and £10 10*s*.

AGRICULTURAL CHEMISTRY,

	£	s.	d.
An assortment of all the necessary Apparatus and Chemicals for the complete analysis of Soils and Manures, of the best size and quality, carefully packed in strong iron-bound chest. For a detailed list of the Articles and Chemicals, see General Catalogue.	42	0	0
Assortment No. 2, containing the same articles as No. 1, but with cheaper balance, platinum crucible, &c.	30	0	0
Assortment No. 3	21	0	0
The Assortments No. 1, 2, and 3, are calculated for a complete quantitative analysis of any soil or manure, as described in Sir H. Davy's Agricultural Chemistry, Liebig's Works, Professor Johnson's Catechism of Agricultural Chemistry, and other standard works on Agricultural Analysis, and are particularly adapted for Farmer's Clubs, Agricultural Associations, and also for exportation.			
Assortment No. 4, containing one or two of each of the most important articles in No. 1	10	10	0
Assortment No. 5, ditto on a small scale	5	5	0
Assortment No. 6, ditto ditto	3	3	0
The Assortments Nos. 3, 4, 5, and 6, are in the form of chests, the Chemicals arranged at the top, and the Apparatus in a drawer below.			
The *Farmer's Chest*, for roughly ascertaining the comparative quantities of the following ingredients in various samples of soils, with directions—stones, coarse sand, fine sand, clay, lime, moisture, organic matter, and iron	2	2	0
Sir H. Davy's apparatus for the analysis of calcarious soils	1	10	0
Hydrometric Glass Beads for ascertaining the strength of sulphuric acid for agricultural purposes, per set of three	0	6	0

Philosophical Apparatus, &c., sold by HORNE, THORNTHWAITE, & WOOD, 123, *Newgate Street, London.*

ELECTRICITY.

	£	s.	d.
Small Cylinder Electrical Machines	1	5	0
2nd Size	2	2	0
3rd do.	3	10	0
4th do.	4	10	0
5th do.	6	0	0
6th do.	8	0	0
9-in. Plate Machines	3	3	0
12 ditto	4	10	0
18 ditto	7	10	0
24 ditto	12	0	0
Set of 5 Spirals	2	2	0
Spiral on Foot	0	8	6
Hand Spiral	0	5	6
Diamond Spotted Jars, 8s. 6d. to	0	15	0
Star, in Frame	0	8	6
Bird, in Frame	0	8	6
Luminous Conductors . from	0	10	6
Magic Picture	0	7	6
Flask	0	6	6
Spider Jar	0	8	6
Cuthbertson's Discharger	2	2	0
Universal ditto	1	10	0
Jointed ditto	0	10	6
Gamut of Bells	1	16	0
Set of Five ditto	0	18	0
Set of Three ditto	0	7	6
Air Cannon . . . 12s.,	0	18	0

	£	s.	d.
Air Pistol	0	6	0
Powder Cannon	0	5	6
Sportsman	1	5	0
Thunder House	0	9	0
Powder ditto	1	1	0
Obelisk	0	7	0
Egg Stand	0	9	0
Image Plates	0	9	0
Pith Ball Stand	0	5	0
Gold Leaf Electrometer	0	16	0
Lane's ditto	0	7	0
Cavallo's ditto	0	15	0
Quadrant ditto	0	7	0
Leyden Jars . from 3s. 6d. to	1	10	0
Pith Balls, per doz. . 1s. to	0	2	0
Pith Figures, each . from	0	1	0
Head of Hair	0	7	0
Electrophorus . from	0	10	6
Batteries . from 10s. to	10	0	0
Insulated Stools . from	0	10	6
Amalgam . per box	0	1	0
Bucket and Syphon	0	5	6
Electrical Cylinders . from	0	3	6
Glass Handles	0	1	3
Ditto Legs	0	1	6
Pocket Electrical Bottle, and Riband for charging the same	0	7	6

PNEUMATICS.

Single Barrel Air Pump, with Receiver . . . 21s., 25s.,	1	10	0
Ditto ditto, with Fountain	2	5	0
Small Size Double Barrelled Pump . 3*l.* 10s.,	4	14	6
Middle Size ditto ditto	7	7	0
Ditto, with Guage Plate	8	8	0
Ditto, with raised Plate	9	9	0
Large Size Double Barrelled Air Pump	12	12	0
Ditto on Stage Stool	19	0	0
Single Transferer	0	16	0
Double ditto	2	2	0
Guinea and Feather Apparatus, 3 falls	1	4	0
Ditto ditto, 2 falls	0	16	0
Syringe and Lead Weight	0	12	0
Fountain in Vacuum, best make	0	15	0
Ditto ditto common	0	7	6
Lungs Glass	0	7	6
Bladder Frame and Lead Weights	0	7	6
Filtering Cup	0	6	6
Fruit Stand	0	5	0
Wheel and Upright Barometers . from	3	3	0
Open and Close Receivers for Air Pump . from	0	3	6
Bladder Glass for ditto	0	3	6
Model of a Water Pump, showing the principle and absurdity of the term "Suction" . . . 21s.,	1	10	0
Ditto of Forcing ditto	2	15	6
Large Size Hemisphere	1	10	0
Middle ditto	0	18	0
Small ditto	0	15	0
Bacchus	1	8	0

	£	s.	d.
Wind Mills on a new and superior construction	3	3	0
Copper Bottle, Beam, and Stand	2	15	0
Bell Experiment from 10s. to	1	1	0
Exhausting and Condensing Syringes	0	7	0
Ditto, in one Instrument	0	10	0
Pocket Condensers for Instantaneous Light	0	3	0
Sliding Wire, and Collar	0	12	6
Ditto ditto Thornthwaite's Improved, with ball and socket joint	0	17	6
Model of Diving Bell	1	5	0

GALVANISM, OR VOLTAIC ELECTRICITY.

Cruikshank's Batteries, in Mahogany Troughs . . . from 1*l.* 1s. 0d. to	5	5	0
Grove's Platinum Batteries, excited with dilute muriatic acid in connection with the zinc, and strong nitric acid in connection with the platinum, from	1	15	0
Smee's Batteries, in round earthenware pots, so constructed that the zincs can be readily replaced by means of a binding screw, without the trouble of soldering or bending:—			
Pints	0	10	0
Quarts	0	12	6
4-Quart	1	5	0
6-Pint ditto, in mahogany tray, so constructed that they may be arranged for quantity or intensity, with flexible conducting wires	3	3	0
6-Quart ditto, ditto	3	17	6
Ditto ditto, in Wollaston's troughs of 12 cells, with double zincs, and the silver plates, presenting a surface of 252 square inches	5	5	0
Ditto ditto, of 432 inches	6	6	0
Cast-Iron, or Maynooth Batteries, per cell	0	7	6

Every description of Apparatus connected with MAGNETISM and ELECTRO-MAGNETISM, for which see General Catalogue.

ELECTRO-METALLURGY.

ELECTROTYPE APPARATUS for procuring, by galvanic action, perfect fac-similies of engraved copper-plates, however elaborate; also, correct copies of medals, seals, plaster casts, and all kinds of metallic ornaments, from 10s. 6d. to 3*l.* 3s. 0d. and upwards.

OPTICAL APPARATUS.

The Patent Pantoscopic Spectacles, the most recent and scientific invention for the improvement of sight, from 7s. 6d. to 25s.; if gold mounted, to £3 3s. See "Smee on Vision in Health and Disease, and the Value of Glasses for its Restoration," p. 64. Price 1s.

MICROSCOPES.

Single Microscopes for Botanical and other purposes . . from 5s. to	1	10	0

ACHROMATIC MICROSCOPES.

Horne and Co.'s improved Medical Compound Achromatic Microscope, with achromatic object-glass, box, brass forceps, &c. &c., magnifying power, from 1000 to 8000, packed in mahogany case or cabinet	5	5	0
Ditto, with jointed pillar and fine adjustment, test objects, &c., magnifying power varying from 1000 to 12,000	7	10	0
Ditto, ditto, magnifying power from 1000 to 25,000	10	10	0
Ditto, ditto, ditto 1000 to 50,000, with extra eye piece, &c.	15	15	0
Very superior Compound Achromatic Microscope, with moveable and safety stage, fine adjustment, two eye-pieces, and two sets of achromatic object-glasses, capable of magnifying from 1500 to 100,000 times, plane and concave mirrors, detached condensing lens, aquatic box, brass forceps, &c., and six objects mounted in balsam, the whole packed in neat mahogany cabinet	21	0	0
Ditto, ditto, of higher magnifying power, and fitted with achromatic condenser, silver specula, polarizing apparatus, &c. . . . . from £35 to	£0	0	0

Philosophical Apparatus, &c., sold by HORNE, THORNTHWAITE, & WOOD, 123, Newgate Street, London.

Messrs. Horne, Thornthwaite, and Wood, beg to call particular attention to their Achromatic Microscopes, which are constructed on the best principles, and can confidently be recommended for all purposes of microscopic research, which now forms such an important feature in the study of animal and vegetable physiology, &c.

Magic and Phantasmagoria Lanterns, Slides, &c., from 16s. to £5 5s., and upwards; if for exhibiting Astronomical Diagrams, Views, &c., from £1 10s. to £21 and upwards. Oxy-Hydrogen Microscopes, Chromatropes, &c.

DISSOLVING VIEWS

(*As shown at the Royal Polytechnic Institution.*)

	£	s.	d.
Complete Apparatus, with Lenses 3 inches diameter, illuminated with Argand Oil Lamps, capable of showing a disk 9 feet in diameter	10	10	0
Views for ditto . . . . . from 7s. 0d. to	0	10	0
Dissolving View Apparatus, illuminated with the Oxy-Hydrogen or Lime Light, capable of showing pictures 20 feet diameter, consisting of a pair of mahogany lanterns, with brass fronts, and dissolving apparatus, 2 pair of 4 inch lenses or condensors, 2 oxy-hydrogen jets and lime burners, flexible tube connections, 2 large India rubber bags and pressure boards, lead bottle, tube, and purifier, for making hydrogen gas, iron retort, &c., for oxygen gas, folding mahogany tripod stand, &c., complete	42	0	0
Ditto, Ditto, with 6 inch condensers	60	0	0
Ditto, Ditto, 9 inch ditto	85	0	0
Views for Ditto, from 25s. to 80s. each, and upwards.			
Oxy-Hydrogen Microscope, with objects fitted to the above . . . from	15	15	0
Ditto, Ditto, complete with the gas apparatus, &c.	35	0	0

ACHROMATIC TELESCOPES.

18-inches long, with rack and pinion, on stand	8	8	0
Ditto, ditto, in German silver	14	14	0
30-inch ditto	12	12	0
Ditto, with vertical rack	14	14	0
Ditto, with vertical and horizontal rack	21	0	0
Ditto, with finder and micrometer	23	10	0
42-inch, with rack and pinion	30	0	0
Ditto, with vertical rack	32	0	0
42-inch, with vertical and horizontal rack-work movement, finder, and micrometer	36	0	0
Ditto, with extra large object glass	40	0	0
Ditto, with equatorial stands . . . . . extra	30	0	0
Telescopes, from 5 to 7 feet, with all the recent improvements, from £100 to	300	0	0

The whole of the above Astronomical Telescopes are furnished with two-day powers, and two or more astronomical powers, and are packed in cases.

REFLECTING TELESCOPES, &c.

One-foot Gregorian Reflecting Telescope, on stand, packed in mahogany case, speculum 9½ inches diameter	6	6	0
One-foot and a-half ditto, speculum 3 inches diameter	11	11	0
Two-feet ditto, speculum 4 inches diameter	16	16	0
Ditto ditto, with rack-work motion	25	0	0
Three-feet ditto, with speculum 5 inches diameter, and rack-work motion	42	0	0
Ditto ditto, with speculum 6 inches diameter, on tripod stand, and rack-work motion	68	0	0
Four-feet ditto ditto, with speculum 7 inches diameter	105	0	0
Seven-feet Newtonian Telescope, with speculum 6 inches diameter	105	0	0
Ditto ditto, with speculum 7 inches diameter	126	0	0
Nine-feet ditto, with speculum 9 inches diameter	210	0	0
Transit Instruments . . . . . from £20 to	180	0	0

Micrometers, &c., &c.

QUADRANTS, SEXTANTS, &c.

Ebony Quadrants . . . . . £2 5 0 to	3	3	0
Ditto ditto with Tangent Screw	3	10	0
Ditto ditto with Telescopes . . . . from 4 4 0	6	6	0

Philosophical Apparatus, &c., sold by HORNE, THORNTHWAITE, & WOOD, 123, *Newgate Street, London.*

	£	s.	d.	£	s.	d.
Ebony Sextants, best				7	7	0
Metal Sextants, on the most improved principle	7	7	0	12	12	0
Ditto, of the best possible construction, divided to 15 sec. or 30 sec., with apparatus, &c., in case from	12	12	0	18	18	0
Artificial Horizons „	2	2	0	5	5	0
Cabin and Binnacle Compasses	1	10	0	5	5	0
Azimuth Compasses	4	4	0	10	10	0
Universal and Ring Dials from	1	5	0	5	5	0
Pocket Compasses, of every description.						

THEODOLITES.

Common Theodolite	9	9	0
4-inch do. do. with Telescope	12	12	0
Ditto, divided on silver	13	13	0
5-inch ditto	18	0	0
Ditto, best construction, with Tangent Screw motion	24	0	0
Ditto, with two Telescopes	36	0	0
6-inch best Theodolite, divided to 20 seconds, with one Telescope	28	0	0
7-inch ditto ditto, with two Telescopes	42	0	0

LEVELS, COMPASSES, &c.

Portable Levelling Instrument, with Telescope and Compass	8	8	0
14-inch Troughton's Level	11	0	0
Ditto, with Tripod Staff	12	0	0
20-inch Troughton's Level	13	0	0
Ditto, with Tripod Staff	14	0	0
20-inch Y Levels, with Telescope	16	0	0
Dumpy Level, without legs or compass	12	0	0
14-inch Dumpy Level, with legs and compass	15	0	0
Common Spirit Levels 3s., 4s., 5s., 6s., and	0	10	0
Spirit Levels, with best Ground Bubbles.			
Miners' Magnetic Compasses, in mahogany cases, with folding sights, from	1	15	0
Prismatic Compasses from £2 12 6 to	3	13	6
Protractors „ 0 2 6 to	7	7	0
Perambulator	9	9	0
Ditto, brass mounted	12	0	0
Ditto ditto and metal wheel	14	0	0
Station Staffs from	2	15	0
Surveying Crosses or Squares from 12s. to	1	11	6
Cylindrical ditto from 18s. to	1	12	0
Circumferentors from £2 12s. 6d. to	6	6	0
Plane Tables from £5 10s. to	12	12	0
Measuring Chains from	0	10	0
Plotting, Marquois, Gunter's Scales, and other Rules.			

DRAWING INSTRUMENTS.

In Fish Skin Cases, in sets from £0 7s. 6d. to	2	2	0
Magazine Sets, in mahogany cases „ £2 10s. 0d. to	18	18	0
Proportional Compasses „ £1 13s. 0d. to	5	5	0

N. B.—Every other description of Instrument used in Practical Surveying.

BAROMETERS, &c.

Best Wheel Barometers from £3 3 0 to	10	10	0
Upright ditto „ 1 10 0	7	7	0
Marine ditto „ 3 3 0	6	6	0
Standard Barometers of the best construction	12	12	0
Improved Simpisometer	3	3	0
Day and Night Self-Registering Thermometers 1 1 0	1	10	0
Sixe's ditto, ditto from 1 5 0	2	2	0
Thermometers of all descriptions „ 0 2 6	5	0	0
Hygrometer (Daniell's)	2	5	0
Ditto (Mason's)	2	10	0
Pluviometers from	1	10	0

EDUCATIONAL MODELS.

	£	s.	d.
A Set of the Mechanical Powers, consisting of various systems of pulleys, different kinds of levers, the wheel and axle, the inclined plane, wedge, model of the screw, a compound engine, and other apparatus complete for illustrating and demonstrating the laws of motion, gravity, and equilibrium of forces, &c., on an extensive scale, *in brass*	50	0	0
Ditto, ditto, on a smaller scale, suitable for schools, &c.	21	0	0
Ditto, ditto, chiefly constructed of mahogany and hardwood, £3 3s., £5 5s., and	8	8	0

Sets of Geometrical Solids from 9s., if with planes and sections for cone and sphere, from 15s. Sectional and other Models of Steam Engines, Hydraulic Presses, and various other Machines, &c., &c.

GLOBES,

Constructed on the newest and best principles, from 6 to 20 inches diameter, containing all the recent discoveries.

Black stained wood frames for the table, particularly applicable for schools—				
20 inch, per pair	9	10	0	
15 ditto	6	0	0	
12 ditto	4	0	0	
9 ditto	3	0	0	
3 ditto	1	15	0	
Mahogany frames—				
20 inch, per pair	10	10	0	
15 ditto	6	10	0	
12 ditto	4	10	0	
9 ditto	3	10	0	
6 ditto	2	2	0	
Carved rosewood frames, very handsome—				
20 inch, per pair	13	0	0	
15 ditto	8	8	0	
12 ditto	6	6	0	
9 ditto	4	14	6	

If the above Globes are required on chair-high frames, with compass boxes, the price will be from £2 2s. to £4 4s. extra, according to the size.

Orreries, Planatariums, Tellurians, &c., &c., to order . . . . from	2	10	0

PHOTOGRAPHIC APPARATUS.

No. 1. Horne and Co.'s complete Apparatus for Daguerreotype and Calotype Processes, for obtaining pictures from 8½ by 6½ downwards, with every requisite for views, portraits, miniatures, &c., including best adjusting camera, with compound achromatic lens, double backs for plates and paper, camera stand, improved bromine and iodine apparatus, plate boxes, polishing frame, mercury box, buffs, washing apparatus, spirit lamp, gilding stand, all the requisite chemicals in stoppered bottles, &c., the whole packed in two cases, with locks and keys . . . . . £70 to	100	0	0
No. 2. Daguerreotype Apparatus complete, for pictures, 8½ by 6½, 6 by 5, 5 by 4, with double achromatic lens, expanding camera, iodizing and bromine apparatus, mercury box, plate boxes, polishing blocks, buffs, gilding stand, spirit lamp, and all the requisite chemicals, &c.	40	0	0
No. 3. Ditto, ditto, for pictures 5 by 4, 4 by 3, and 2¾ by 3¼	30	0	0
No. 4. Ditto, ditto, ditto, 4 by 3, 2¾ by 3¼, and 2½ by 2 . . £18 18s. and	20	0	0
No. 5. Ditto, ditto, ditto, 3¼ by 2¾, and 2½ by 2 . . . £10 10s. and	12	12	0
No. 6. Daguerreotype Apparatus complete, with single achromatic lenses, from £6 6s. to	22	0	0
Calotype Apparatus complete, for obtaining pictures on paper, including a Cundell's camera of best construction, the requisite chemicals in stoppered bottles, scales and weights, reversing frame and glass, glass measure, earthenware trays, glass plates, paper, &c., packed in case, with lock and key . . . . . £10 10s. and	15	15	0
Ditto, ditto, with fewer apparatus, &c. . . . . £3 3s., £5 5s., and	8	8	0
Calotype, or Talbotype Apparatus, of the best description, including a folding achromatic camera, and every other requisite for obtaining full-sized pictures, packed in two portable cases, and particularly adapted for travellers	25	0	0

		£	s.	d.
Cameras with single achromatic or double achromatic lenses, from £1 1s. 0d. to £20 0s. 0d., according to the diameter of and kind of lens employed.				
Horne and Co.'s improved Compound Achromatic Lenses, mounted in brass fronts, with a delicate rackwork adjustment, and brass ring for adaptation to the camera.				
No. 1. For Pictures 8½ by 6½, combined focus 12 in., diameter of lenses 4 in.		25	0	0
No. 2. Ditto 6 by 5, Ditto 8 in., Ditto 3½ in.		15	15	0
No. 3. Ditto 8½ by 6½, Ditto 12 in., Ditto 3½ in.		12	12	0
No. 4. Ditto 4 by 3, Ditto 6 in., Ditto 2½ in.		8	8	0
No. 5. Ditto 6 by 5, Ditto 8 in., Ditto 2½ in.		7	7	0
No. 6. Ditto 4 by 3, Ditto 6 in., Ditto 2 in.		4	14	6
No. 7. Ditto 3¼ by 2¾, Ditto 6 in., Ditto 1¾ in.		3	13	6
Messrs. H., T., and W. have much pleasure in recommending the above combinations, as producing remarkably sharp and brilliant pictures, free from aberration, and in the shortest space of time.				
Single Achromatic Lenses, unmounted,—				
1¼ inch diameter, 4 inch focus, and upwards		0	6	0
1¼ Ditto 5 Ditto		0	8	0
1¾ Ditto 6 Ditto		0	10	6
2 Ditto 8 Ditto	14s. and	1	10	0
3 Ditto 12 Ditto		3	3	0
Parallel Mirrors, mounted in frame, to attach to the front of the camera, for taking pictures in a correct position for ¼-plate lenses		3	3	0
Ditto ½-plate ditto		4	4	0
Plano-Convex, Crossed, Meniscus, and every other description of Lens required in Photographic Experiments.				
Silvered Plates, of the best English manufacture, of all sizes.				
Plate Boxes, for holding the prepared Plates, in walnut-wood, mahogany, or japanned metal.				
Pans of hard glazed Porcelain, for containing iodine or accelerating mixtures, with ground plate glass covers, for any size plates, up to 4 in. by 3 in. . ea.		0	2	0
Ditto, ditto, in mahogany or walnut cases, with three frames for holding the various sized plates		0	12	0
Ditto, ditto, with levelling screws, &c.		1	1	0
Iodine Boxes, lined with glass	from	0	6	0
Iodizing or Bromine Troughs, with set of frames, consisting of deep glass pan, enclosed in mahogany case, air-tight glass cover, mirror, &c., for plates, 4 by 3 downwards	£1 4s. and	1	10	0
Ditto, for Plates, 6 by 5 downwards	each £1 10s. and	2	2	0
Ditto, ditto, 8½ by 6½ ditto	„ £3 10s. and	4	4	0

IMPROVED IODIZING AND BROMINE APPARATUS,

Consisting of two stout glass pans, enclosed in mahogany or walnut-wood case, with spring bottoms and air-tight glass covers. Two mirrors are placed on one side, for viewing the plate while being prepared, and, on the other two, apertures for the admission of light. The great advantage of this form of apparatus for preparing plates, consists in the facility and certainty with which the sensitive coatings are applied:—				
No. 1, for Plates from 8½ by 6½ downwards		8	8	0
No. 2, for Plates from 6 by 5 downwards	£3 10s. and	4	4	0
No. 3, for Plates from 4 by 3 downwards		2	10	0
Plate Cleaners	from 2s. to	0	6	0
Velvet Buffs, for polishing plain	from 1s. 9d. to	0	2	6
Ditto, improved, with handle	3s. to	0	10	0
Metal Frames for holding the plates, while polishing in lathe or hand:—				
For plates, 2½ by 2		0	5	0
Ditto 3¼ by 2¾		0	7	6
Ditto 4 by 3		0	9	0
Mercury Boxes of the most improved kinds	from 13s. to	2	2	0
Ditto, of larger size	from £2 2s. to	4	4	0
Double folding Tripod Stand, with ball and socket movement, &c.,	£2 2s. and	3	3	0
Ditto, ditto, plain, not jointed		1	17	
Horne and Co.'s improved Portable Universal Stand		2	2	0
Ditto, ditto, with jointed top and legs		2	15	0
Earthenware Washing Tray and Stand		0	3	6

		£	s.	d.
Ditto, ditto, small size		0	1	6
Washing Trays, in copper and glass	from	0	2	6
Glass Spirit Lamps	2s., 3s., 4s., and	0	5	0
Ditto Graduated Measures	2s., 2s. 6d, and	0	3	6
Ditto Mortars and Pestles	from	0	2	6
Ditto Stirring Rods		0	0	3
Ditto Funnels		0	0	6
Brass Spirit Lamps	from	0	3	6
Brass Stand, for fixing by chloride or hyposulphite of gold		0	3	6
Improved ditto, with adjusting screws	4s. 6d. and	0	10	6
Ditto, ditto, best construction, with adjusting screws and springs		1	1	0
Brass Spirit Lamps, with levelling screws		0	5	6
Head Rests to attach to chair for steadying the head whilst taking portraits		0	7	6
Improved ditto, on heavy iron foot, so as to be independent of the chair		3	3	0
Finely carded Cotton Wool	per oz.	0	0	3
Ditto ditto	per lb.	0	4	0
Retorts and Retort Stands, Receivers, Flasks. &c.				
Copper and Tin Stills, with worm and tub complete, for drawing distilled water,	£1 1s., £1 5s., and	2	2	0
Claudet's Brass Frames, for retaining prepared plates	each 10d., 1s., and	0	1	2
Improved ditto of japanned tin, with covers	each	0	2	0
Prepared Goldbeater's Skin, for fastening pictures in frames, cases, &c.,	per doz.	0	3	0
Pliers for holding plate over spirit lamp for drying off, &c.		0	2	0
Silver plated Washing Apparatus, for taking any size picture up to $4\frac{1}{4}$ by $3\frac{1}{4}$,	from	0	15	0
Dark Lanterns, with yellow glass slide		0	12	0
Redman's Prepared Colours for colouring daguerreotype pictures, in cases containing 12 different tints in bottles, gold and silver shells, prepared brushes, &c., complete		1	1	0
One Quart Filterer, with brass cock complete		0	10	0
Half gallon Stone Barrel, with brass cock		0	6	0
Instrument to count seconds, with alarum		3	0	0
Ditto ditto without alarum		1	5	0
Portable Rectangular Frame, for preparing sensitive paper		0	2	0
Ditto ditto best make		0	5	0
Camel's Hair Brushes, for photographic purposes	6d., 1s., 1s. 6d., and	0	2	0
Ditto ditto for colouring daguerreotypes	each, from	0	0	3
Pressure Frames and Glass, for obtaining positive photographs, or copying engravings, lace, leaves, &c.	5s., 7s. 6d., 10s. 6d., and	1	1	0
Earthenware Trays, for washing and setting pictures	1s. 6d. and	0	2	0
Tin Vessels for heating photogenic drawings	3s. and	0	5	0
Monier's pure White Paper	per quire	0	1	6
Whatman's Turkey Mill (selected)		0	1	6
Turner's ditto		0	1	6
Sandford's superior ditto, prepared expressly for Photographic purposes, folio		0	4	0
Ditto ditto, quarto		0	2	0
White wove Blotting Paper	per quire	0	1	6
Scales and Weights, common		0	3	6
Ditto ditto, best make, with glass pans		0	18	0

MOROCCO CASES AND FRAMES.

Morocco Cases, lined with silk velvet, and gilt mats, with square cushion, oval and other mats for pictures, $4\frac{1}{4}$ by $3\frac{1}{4}$		0	5	6
Ditto, 4 by 3		0	5	0
Ditto, $3\frac{1}{4}$ by $2\frac{3}{4}$		0	3	0
Ditto, $2\frac{1}{2}$ by 2		0	2	0
Morocco Frames, with suspension ring mats and glasses, for plates, $4\frac{1}{4}$ by $3\frac{1}{4}$		0	3	6
Ditto ditto, 4 by 3		0	3	0
Ditto ditto, $3\frac{1}{4}$ by $2\frac{3}{4}$		0	2	3
Ditto ditto, $2\frac{1}{2}$ by 2		0	1	3
Skeleton Frames, to contain Daguerreotype Pictures.				
Common ditto, with black line border, on paper, for plates, $2\frac{1}{2}$ by 2	8d. to	0	1	0
Ditto ditto, $3\frac{1}{4}$ by $2\frac{3}{4}$	9d. to	0	1	0
Ditto ditto, 4 by 3	1s. to	0	1	4
Ditto, enamelled glass, with black line border for plates, $2\frac{1}{2}$ by 2	10d. to	0	1	2
Common ditto, painted on glass, with black line border for plates, $3\frac{1}{4}$ by $2\frac{3}{4}$	1s. to	0	1	3

		£	s.	d.
Ditto ditto, 4 by 3	1s. 3d. to	0	1	6
Best ditto, with ornamental gilt borders, of various forms and patterns, for plates, $2\frac{1}{2}$ by 2	1s. 4d. to	0	1	8
Ditto ditto, $3\frac{1}{4}$ by $2\frac{3}{4}$	1s. 6d. to	0	1	9
Ditto ditto, 4 by 3	1s. 9d. to	0	2	6
The price of the above Frames, if taken by the dozen, would be considerably lower.				
Gilt Mats, square, oval, dome top, and cushion shape, $2\frac{1}{2}$ by 2	per doz.	0	6	0
Ditto ditto, $3\frac{1}{4}$ by $2\frac{3}{4}$	ditto	0	12	0
Ditto ditto, 4 by 3	ditto	1	4	0
Ornamental lacquered Brass Frames	2s., 2s. 6d., and	0	4	0
Papier Maché Miniature Frames, with oval or square sights	from	0	3	6
Superior chased Gold Lockets and Brooches, with plain and engine-turned backs, for containing daguerreotype pictures	from	0	15	0
Bracelets, Snuff Boxes, &c., for ditto ditto.				

PURE CHEMICALS.

PREPARED FOR PHOTOGRAPHIC PURPOSES.

Iodine, Commercial	variable			
Ditto, Pure	per ounce	ditto		
Ditto, Bromide Solution	ditto	ditto		
Ditto, Chloride Saturated	ditto	ditto		
Ditto, ditto, Diluted	ditto	0	4	0
Ditto, Tincture	ditto	0	1	0
Bromine, Pure	ditto	0	4	0
Ditto, Chloride	ditto	0	3	0
Liqueur Hongroise, or Hungarian Solution		0	1	0
Redman's Sensitive Solution	per bottle, 2s. 6d. and	0	4	0
Woolcott's American Accelerator	per bulb	0	0	8
Distilled Mercury	per ounce	0	0	6
Hyposulphite Soda		0	0	6
Ditto ditto	per lb.	0	5	0
Chloride Gold, Crystals (pure)	per dram	0	12	0
Ditto ditto	per grain	0	0	3
Ditto, Solution	per ounce	0	5	0
Oxide Gold	per dram	0	18	0
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A

DISSERTATION

UPON THE

NERVES;

CONTAINING

AN ACCOUNT,

1. OF THE NATURE OF MAN.
2. OF THE NATURE OF BRUTES.
3. OF THE NATURE AND CONNECTION OF SOUL AND BODY.
4. OF THE THREEFOLD LIFE OF MAN.
5. OF THE SYMPTOMS, CAUSES AND CURE OF ALL NERVOUS DISEASES.

By W. SMITH, M. D.

And the Lord God formed Man, of the Duſt of the Ground; and breathed into his Noſtrils the Breath of Life: and Man became a living Soul. Gen. ii. 7.

LONDON:

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IT is hoped, that the candid Reader will not look, with too ſevere an eye, upon the few typographical errors, he may perhaps meet with, in the following Diſſertation: in ſome of the firſt *Formulæ*, he will find *qut*. and *qnt*. inſtead of *gut*.; which miſtakes of the printer were diſcovered too late to be corrected.

SECT. I.

CHAP. I.

Of the NATURE of MAN.

IN treating of Nervous Diſeaſes, I ſhall ſhew that Man is a compound being; made up of a material and an immaterial part; having a neceſſary and mutual dependance, connection, and influence upon each other; ſo that a change in the one neceſſarily induces a proportionable change in the other: And in the next place I ſhall conſider the nature, manner and conſequences of that dependance, influence and connection: And laſtly, lay down ſome rules and methods of reſtoring the animal œconomy to its regular ſtandard, when loſt or impaired by any diſeaſe called NERVOUS.

The immortality of the Soul is ſo clearly revealed in Scripture, and the truth of the

Scriptures ſo clearly and inconteſtibly proved; that this doctrine is not capable of greater evidence and certainty, than it is ſupported with from this quarter. I ſhall however paſs over thoſe texts, that clearly reveal the diſtinction between Soul and Body, as being of different natures and perfections, the one material, periſhable, and liable to external injuries; the other immaterial, immortal, and impaſſible: neither ſhall I take the aſſiſtance of the arguments that might be urged, from the conſent of mankind; which ſhew it either to be the voice of Nature; or, which is much the ſame, the remains of an univerſal tradition, from the firſt man. All that the deſign of this performance requires of me, is to conſider ſome of the proofs and arguments that are drawn from reaſon, and to ſhew, that from the principles of philoſophy, we are either obliged to believe the exiſtence and immortality of the Soul, or to give our aſſent to abſurdities and contradictions.

Firſt. I need not go about to ſpend time in proving, that we all bear about us a body, with modes, properties, and qualities, common

common to the whole maſs of matter, ſuch as extenſion, bulk, figure, &c. as there is no ſceptic ſo wild as to deny it. Conſciouſneſs and experience, the beſt proof in the world, ſhew us that we have a thinking principle within us, to direct our actions, endowed with modes, properties, and qualities, of a peculiar nature, ſuch as judging, reflecting, perceiving, &c.

Now, I believe there is no greater demonſtration of any two things being of different natures, than, to ſhew, that the modes, properties, and qualities of the one, are inconſiſtent with, entirely different from, and cannot, without abſurdity and contradiction, be affirmed of the modes, properties, and qualities of the other. There is no greater evidence of the certainty and truth of any propoſition, than to demonſtrate the contrary both abſurd and contradictory. This is allowed in *mathematics*, a ſcience that admits of the greateſt certainty under the ſun. EUCLID thinks there cannot be a better proof that a *ſquare* is not a *circle*, or a *circle* a *ſquare*, than that the properties of a ſquare cannot be affirmed of the proper-

ties of a circle, nor the properties of a circle affirmed of the properties of a ſquare, without abſurdity and contradiction. If then the properties of body cannot be applied to the properties of that thinking principle within us, nor the properties of the thinking principle within us applied to the properties of body, without abſurdity and contradiction; then it neceſſarily follows, that that thinking principle within us cannot be *body* or *matter*, but if it is not body and matter, it muſt be *Soul*, and *immaterial*.

The properties of the thinking principle within us, are perception, thinking, willing, &c. and what flow from them, as comparing, judging, doubting, denying, &c. The properties of body are, figure, bulk, extention, weight; and ſuch as reſult from theſe, as ſoftneſs, hardneſs, roughneſs, &c. Now let us, or any man examine, whether the properties of the thinking principle within us, are any way conſiſtent with the properties of body, or can be applied to them, without abſurdity and contradiction. Hath a perception or reflection, any figure or bulk?

bulk? Can we ſay, a ſcarlet judgment; an oblong doubt; a ſquare denial; or a reflection of a foot long, or of a pound weight? If this cannot be ſaid, without abſurdity and contradiction, then it follows, that the thinking principle within us is of a nature as different from body, as its properties and affections are, from the properties and affections of body; that is to ſay, the thinking principle within us, called SOUL, is of a quite different nature from body: but the body is not immaterial, but material, or matter; therefore the ſoul is not material, or matter, but immaterial, or ſpirit.

It is objected to this, that though thinking is not a property, mode, or affection of matter, as ſuch, yet God can ſuperad a power of thinking, to a ſyſtem of matter rightly diſpoſed.

That God can ſuperadd to any body, ſomething that is not body, is what none that believe in a God, can deny; ſo hath he added a reaſonable ſoul to theſe bodies of clay which we carry about us: but to ſay, that matter has a power to think, of itſelf, from ſome new property, which obſerva-

tion

tion and experience hath not discovered to belong to it, is highly absurd and unjustifiable: it is contrary to the laws and rules of philosophy, and common sense, to ascribe any property to any thing that neither observation nor experience hath ever found to belong to it.

No composition of matter and motion, or any of their affections, can be made to think as that immaterial substance, in man, called Soul, doth: because it is impossible, in the nature of things, that matter and motion, in themselves incogitate and senseless, can become cogitate and sensible, by division and change of place; which is all that motion can produce in any unorganized system of matter, in order to receive or become a spiritual, immaterial, thinking *essence*. Divide matter, ad infinitum, subtilized to the highest degree, after all, it still remains matter; its *essence* it still preserves, and continues foreign to the capacity of thinking: Bodies may be changed as to their form, yet none can be changed in their *essence*; for the greatest and firmest parts in our bodies, are constituted of the very same

ſame matter with that which is ſmalleſt or leaſt firm: for example, the greateſt and hardeſt bone is made up and conſiſts of the ſame matter with that of the lymphatic veſſels. Air is between eight hundred and a thouſand times lighter than water; and Mr. Boyle has proved, by experiments, that it may be thinned fourteen thouſand times more than what it is upon the earth's ſurface, without heat, and vaſtly more with; yet no body, in his ſenſes, ever dreamed, that air, in its moſt rarified ſtate, differs in its eſſence from what it is in the groſs.

Matter is capable of infinite diviſion and addition: there may be ſyſtems of bodies of all ſizes, from infinitely ſmall, to infinitely great; the Stars may be conſidered as a ſyſtem of bodies infinitely great; and Light, a ſyſtem of bodies infinitely ſmall, and how many other ſuch ſyſtems there may be, none can tell. Matter may deſcend, ad infinitum, in tenuity and ſubtilety, and a few of the firſt ſteps we may go, in this infinite progreſſion. I do not mean infinite, in the higheſt degree, but indefinite, or infinite,

nite, in a relative ſenſe, in regard to a finite capacity. The works of God are inſcrutable to perfection; mercury is groſſer than water, water than air, air than light, light than æther; and how far further nature may go, in deſcending in tenuity, ſubtilety, and refining, none can tell. The analogy of things, the infinite diviſibility, and encreaſe of matter from finite, till it comes to infinite, great or ſmall, (relatively ſpeaking) ſhew that Nature never paſſes from poſitive to negative qualities; till it goes through the medium of nothing, or infinite ſmall of the ſame denomination: it never paſſes from motion to reſt, but thro' infinitely ſmall motion. So that matter obſerves, or is ſubject to the ſame laws, in all its diviſions, however far it may be ſubtletized beyond the ken of our ſenſes. Therefore, it is impoſſible to conceive, how thought ſhould ariſe from an organized body, independant of an immaterial ſubſtance. Hence thought and matter give us an idea of different ſubſtances, and it neceſſarily follows, that *that thinking eſſence*, SOUL, is immaterial, and muſt neceſſarily reſide ſome where in the body, where the organs of the

ſeveral

ſeveral ſenſes terminate, and that ſeems to be in the *Senſorum*. The large ſize, the wonderful texture, great care and ſecurity, the God of nature has employed about the Brain, make it highly probable, that it is deſigned for the nobleſt uſes, the Temple, Tabernacle, or Dwelling-houſe of *that immaterial Being, that immortal Gueſt, that Spark of the Deity, that Breath of Life, the Living Soul of Man.*

Again, if the principle of both parts of this compound was one, or if the whole had but a material or organical principle, or if there was only an external ſpring of motion and action; then the whole would die, expire, and be extinguiſhed, as ſoon as the functions die, expire and go down. But the contrary of this is evident, from the latent principle of animation remaining, after all the ſenſible ſigns and functions of life ceaſe. For life and animation are impoſſible and a contradiction to mere mechaniſm, that is, to matter acted by the determinate laws of motion, and in proportion to the ſurfaces of bodies. Indeed the ſelf-moving, ſelf-active, and living princi-

ple concurs with, and homologiſes to mechaniſm, in the animal functions, and operations; which take place according to its own laws. Mechaniſm is actuated by animated, living bodies, or ſpiritual ſubſtances; and this ſelf-moving, ſelf-acting principle, cannot act harmoniouſly, or according to the intended uſes, and purpoſes, upon an unfit, unfiniſhed, or unorganiſed body, as afterwards I ſhall have occaſion to prove.

It appears to me, ſays Dr. Whytt, (who has been accuſed of materialiſm, and indeed I cannot vindicate his doctrine from theſe unhappy concluſions, though I verily believe he did not ſee them) unphiloſophical, to attribute active powers to what, however modified, or arranged, is yet no more than a ſyſtem of matter. Matter cannot of itſelf, by any modification of its parts, be rendered capable of ſenſation, generating motion, or thinking. Matter, as far as we are able to judge of it, by all its known properties, appears to be incapable either of ſenſation, or thought: and the whole phenomena of the mere material world evidently ſhew that it acts invariably, according to certain

certain laws preſcribed to it, add without any feeling, inclination or choice of its own: nor is there any thing more reſembling will, ſelf-determination, or real active power in the moſt refined, and ſubtile parts of matter, than in the groſſeſt, and moſt ſluggiſh. The body only is a covering, armor and defence to the ſoul. When the eye is in danger, the *ſoul ſhuts* the eye-lid; when the head, or other part is in danger, the ſoul raiſes the hand in its defence; and of this body the ſoul has as great care, as, man has of the houſe, in which he dwells. In another place the Doctor ſays, Matter, of itſelf unactuate by any higher principle, is equally as incapable of ſenſe or perception, pleaſure or pain, as it is of ſelf-motion. Fire is as incapable of thought or reflection, as water or earth: and it is impoſſible, that ſelf-motion, ſenſe, or reaſon can poſſibly reſult from the figure, connexion, ſituation or arrangement of the various parts of the body.—From theſe two quotations it is evident the Doctor did not believe the materiality of the ſoul: yet the concluſion, that neceſſarily flows from his doctrine of

vital motion, is the diviſibility of the ſoul, conſequently its materiality.

Dr. Brown, in his Proceedure of the Human Underſtanding, ſays, p. 165, "The "queſtion ſo much debated, and ſo tediouſly "purſued by ſome, *Whether God by his Al-* "*mighty power can ſuperad to our idea of* "*Matter a faculty of thinking?* is ſhame- "fully trifling and frivolous, unbecoming "men of common ſenſe, but much more "philoſophers and metaphyſicians. The "very queſtion ſuppoſes that matter hath "nothing of thinking in its *own nature*, "and this is readily owned by them; be- "cauſe of the plain conſequence; that of "thinking was natural to matter, then "every particle and every ſyſtem of it "would think: ſo that the queſtion can "have no more meaning in it than this, "Whether God can alter the very nature "of matter, ſo that it ſhall be matter and "not matter at the ſame time? Whether "he can make the ſame thing to be a "thinking and unthinking being at the "ſame time? To make the queſtion ſenſe, "it muſt be, Whether God created matter

"with

" with an aptitude and capacity to think,
" in a particular texture and combination
" of its particles into any ſyſtem whatſo-
" ever, or by the addition of any particular
" motion added to it? But if ſo, then
" thinking would be a *primary*, *eſſential*
" quality of matter, whenever it ſubſiſted
" under that particular requiſite diſpoſition
" or motion of parts; and then again, do
" but change this diſpoſition of its parts,
" and put them into another motion and
" ſituation, which are things merely acci-
" dental to it, then it loſes that eſſential
" quality of thinking. And thus the ſame
" faculty ſhall be eſſential and not eſſential,
" accidental and not accidental to the ſame
" thing. So that now the doubt is neceſ-
" ſarily reſolved into the firſt ſenſeleſs queſ-
" tion again, Whether Almighty power
" cannot ſuperad to matter an eſſential qua-
" lity which is unnatural to it? If men
" ſhould give themſelves to ſtarting ſuch
" queſtions about every thing in nature
" and religion, whether Almighty power
" cannot alter every thing from what it
" is, and make it ſomething elſe, what
" jargon would they make of phiſoſophy

and

" and divinity? The true queſtion is what " Almighty power *hath* done, and not " what it *can* do? Sure they muſt be very " zealous for the materiality of the ſoul " who raiſe a queſtion, whether God may " not interpoſe his Almighty power to work " againſt nature and alter the general laws, " properties and courſe of it in every man " that is born?" Another learned gentleman ſays " the moſt obvious idea we have " of matter, is an *extended impenetrable* ſolid " *ſubſtance uncapable of moving itſelf, or of* " *being moved, but* by the *agency and im-* " *preſſion of ſome ſuperior external active cauſe.* " From whence it will undoubtedly follow, " that mere matter, however modified, ex- " alted or purified, will be as incapable of " ſelf motion, as it was in its loweſt ſtate " of denſity or depreſſion; and conſe- " quently cannot by any power, be tranſ- " muted or ſublimated into a living ſelf- " moving ſubſtance. Matter indeed is ſuſ- " ceptible of motion or capable of being " moved, but the motion itſelf muſt pro- " ceed from ſomething diſtinct from and " ſuperior to matter: For the omnipotent " Creator, if we may ſo ſay, cannot make

" matter

" matter think, becauſe it deſtroys its eſ-
" ſence and changes the eſſential properties
" of it; and omnipotence itſelf cannot pro-
" duce impoſſibilities, cannot effect con-
" tradictions, cannot make the ſame thing
" to be and not to be at the ſame time;
" cannot make a ſubſtance, which, as ſo-
" lidly extended, muſt reſiſt all change of
" ſtate, become life, ſenſe, and ſpontane-
" ous motion; for that is directly affirm-
" ing, that the ſame portion of matter,
" which is unactive, dull and dead, may
" be, at the ſame time, living, ſenſible and
" ſpontaneouſly moving. Therefore what-
" ſoever begins motion, where it was not,
" and ſtops it, where it was, that effects a
" change from reſt to motion, and from
" motion to reſt, and that arbitrarily can
" never be matter, whoſe eſſential property
" is an indifference to motion or reſt."

Again, the power of numbers and Geometry joined to the aſſiſtance of mere mechaniſm, that is, foreign impreſſed motions, according to certain laws, and in proportion only to the ſurfaces of bodies, may and do account for the appearances of vegitation,

vegitation, but can never account for animal life, in the loweſt inſect.

For the bodies of brute animals are actuated, by a principle of the like kind, with that placed in man, but inferior with regard to the degrees of reaſon and intelligence which it poſſeſſes. In the more perfect brutes, this principle is plainly intelligent, as well as ſentient; and their actions evidently ſhew them to be endowed, not only with a ſtrong memory, but with reflection and ſome degrees of reaſon.

It is really wonderful to ſee, that there are any to be found, that can ſeriouſly believe, that theſe are machines formed intirely of matter, and, as it were, ſo many curious pieces of clock-work, wound up, and ſet a going; and that the actions of the moſt perfect brutes, are the reſult of mere mechaniſm. In the inferior orders of brutes, the appearances of reaſon, and reflection, are more obſcure; and in the loweſt ſpecies of animals, there are no marks of intelligence; nor do we obſerve them to differ otherwiſe from vegetables, than as

they

they are endued with ſome degree of ſenſation and ſelfmotion. But in all brutes, even in the very loweſt kind of them, there is evidently a ſentient principle. But the ſoul of man enjoys all the powers and faculties, belonging to the ſouls of inferior creatures, and has reaſon, in a much higher degree, ſuperadded to theſe powers. So that *the ſoul* of man differs from that of a brute, viewed in one light, as the fineſt, moſt perfect and completely adjuſted and proportioned machine, to a clumſy, ill-contrived, ill-proportioned one. But the grand and fundamental difference, that diſtinguiſhes the ſoul of man, from that of a brute, is the divine influence, the operation of the Holy Ghoſt, the principle of immortality, whereby we cry *Abba Father*; whereby we become heirs of God and joint heirs with Chriſt, whereby we are intitled to the kingdom of heaven. This diſtinguiſhing principle is, what Adam received, when God breathed into his noſtrils the breath of life; which would have preſerved his ſoul to all eternity; if the Almighty had not immediately interpoſed to annihilate it. But more of this after-

wards, when I come to conſider the three diſtinct lives of man.

God Almighty, as I obſerved before, can conſtitute a new kind of matter, diſtinct from all other kinds of matter; and to it ſuperad the faculties, we diſcover our ſouls to be poſſeſſed with. But then, theſe faculties are not in matter, but ſuperaded to matter. And if God Almighty makes matter to think, yet 'tis impoſſible, in the preſent ſtate of things, he ſhould oblige us to believe it. Becauſe it is contradictory to all the ideas, he has given us of matter. The idea all mankind have of matter, is, that it is a lifeleſs, extended, unactive, paſſive principle; and the idea they, at the ſame time, have of the thinking principle within, is, that of an active, living, unextended principle. So that, theſe two are directly oppoſite, and as plainly inconſiſtent, as light and darkneſs. 1ſt. We move and reaſon from ourſelves, which plainly implies the power of motion within ourſelves; but this is a power abſolutely inconſiſtent with the paſſive, inert nature of matter; called *vis inertiæ*. Therefore, as long as

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our firſt idea of matter includes in it a paſſive inert nature; it includes alſo an utter incapacity of thought.

Again, freedom and liberty to act, or ceaſe from action, to apply ourſelves to contrary motions, and purpoſes, is a clear argument againſt the materiality of the ſoul. For all matter, as far as can be perceived, by the moſt diſcerning, and curious obſervers of nature, is acted by certain, fixed, and invariable laws of motion: and therefore, it is utterly unintelligible, abſurd and contradictory, to ſay, that a neceſſary paſſive principle, tied down to known neceſſary laws, can be the ſource of that freedom and ſpontaniety, we feel in ourſelves. Hence we are brought to aſſert, that contradictory and inconſiſtent properties, may ſubſiſt, in the ſame ſubject, activity and inertneſs, freedom and neceſſity.

2dly, It is evident, that the affections of matter, are inſeparable from figure and extenſion. Nor can we conceive it poſſible, even for the Almighty, to ſuperad any new property of matter, that is not neceſ-

ſarily connected to theſe two; that is, to create matter, without figure and extenſion. Therefore, if thought and its modes be ſuperaded to matter, they muſt be figured and extended. But I appeal to experience, and the obſervation of all mankind, whether they are ſo or not. Hence we run ourſelves upon the abſurdity of ſaying, that, tho' all the properties of bodies are inſeparable from figure and extenſion; yet, the ſoul is a body, with properties, that have no relation to, and are entirely devoid of figure and extention.

3dly, If there be any ſuch thing, as a thinking ſyſtem of matter, I believe it will be allowed, that it is what we carry about us. But, I think, it is evident, that this body of ours, neither thinks in the whole nor in its parts; for conſciouſneſs and reflection are eſſential to thought. Therefore, if this body thought, it muſt neceſſarily be conſcious to itſelf, that it did think; whereas it is ſo far otherwiſe, that we are conſcious to ourſelves, and convinced that it doth not think. Hence we are forced to conclude, that there may be ſuch a thing,

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as a thinking ſyſtem, devoid of conſciouſneſs, and reflection; that is, a thinking ſyſtem that cannot think.

Laſtly, I believe it will be allowed, that our ideas or thoughts are immaterial, that is, are not bodily ſubſtances. Who ever thought there was any thing corporeal, in a judgement, a doubt, &c? If our thoughts are corporeal, where could they be lodged? how infinitely complicated and extended muſt that material Soul be, to be able to contain thoſe immenſe volumes of learning, which ſome men have treaſured up, in their Souls? If, therefore, our ideas be immaterial, as moſt certainly they are, then let any man tell, if he can, or even imagine, how they can ariſe from a material ſubject, or be repoſited in it.

From all theſe propoſitions, and each of them in particular, 'tis clearly evident, that this thinking principle within us, called SOUL, is immaterial, that is, not body. But if immaterial, then indiviſible, for diviſibility is an affection of matter. And if indiviſible, then it is one uncompounded eſſence:

ſence. Then it is incapable of any injury from without; that is, cannot be burned, bruiſed, pierced, or torn aſunder; for all theſe imply parts and diviſibility. Nor can it ſuffer, from the fermentation, and conflict of jarring principles within, for that too would imply a compoſition. And if it is liable, neither to injury from within, nor from without, it is immortal, capable only of being deſtroyed or annihilated, by God Almighty alone.

Some perhaps will be ready to obſerve, that, as I affirm the bodies of Brute Animals to be actuated by a principle of the like kind, with that placed in Man; therefore the Souls of Brutes muſt live for ever: and indeed it is a very neceſſary inference, and what is my real opinion. For an immaterial ſubſtance is not ſubject to the laws of mortality; and periſhes only by the immediate annihilating hand of its Maker, the Almighty God, the Lord Jehova.

This is not a new doctrine, though to many it may appear to be ſo. Some of the moſt learned Primitive Fathers, in the early

ages

ages of the church, thought ſo; and ſome of the gentile Philoſophers were of the ſame mind. How God will diſpoſe of the ſouls of brutes, after death, is not revealed to us; conſequently we are entirely ignorant of it, as we know nothing of any life, but what is revealed to us. Perhaps God Almighty will annihilate them; and perhaps he will ſuffer them to follow their own nature, and live for ever. This I know, that the Almighty hath appointed certain laws to bodies, which he never ſeems to violate, by an uncommon or ſupernatural influence, except for ſome very great purpoſe. Some quote Eccleſiaſtes, ch. iii. v. 21, 'Who knoweth the ſpirit 'of man that goeth upward, and the ſpirit 'of beaſt that goeth downward to the 'earth?' to prove that beaſts periſh after death. The text, indeed, makes a diſtinction, between the ſoul of a man, and that of a beaſt; and plainly declares, that they go to ſeperate places; but, I think, it does not declare, that the ſoul of a brute periſheth, any more than that of a man. But what places of abode are allotted to them,

or

or where, is more than I or any mere man can tell.

Many Divines, with more zeal than reason, have been very solicitous, to prove, that brutes have no soul, thinking that the contrary opinion derogates from the dignity of man. But when the creation was finished, God saw that all was good; therefore, I think, it is no reproach to an archangel, to say, that God made a worm as well as him. Those zealous divines, that contend for the materiality of brutes, are reduced to such absurdities, which would make a modest man blush; but that is an affection of matter which one part of their bodies, viz. the face, is little accustomed to. This I think, that if the Parson gets his old gray mare to ride upon, in the other world, she should, for his contemptible opinion of her, in this life, throw him into the dirt; where I should take the liberty to leave him, and proceed to my next consideration; but this subject is so pleasing and entertaing, that, for all the haste I am in, I shall stop a little here, and briefly consider the nature of brutes.

CHAP.

CHAP. II.

Of the NATURE of BRUTES.

AN underſtanding no doubt Brutes have, of ſuch a kind and degree, as is ſufficient, at leaſt, for their ſtate and rank in the univerſal ſyſtem, and the ſeveral duties and offices, for which they were intended by their Creator. Some of them diſcover almoſt more reaſon and underſtanding, than ſome, that carry about the human form. Upon this principle, we treat our domeſtic animals; we correct them, when they do amiſs, and careſs them, when they do well.

They are ſenſible of pain and pleaſure; which they diſcover, by geſtures, looks and ſounds; and are endued with every perfection, that their rank, in the ſcale of beings required. What abſurdity or hereſy then is there in ſuppoſing, that the ſame Infinite Power, that could form the body of the moſt minute inſect, with ſuch exquiſite proportion and beauty, could, at the ſame

time, with the ſame eaſe, provide a proper inhabitant, to animate and govern it, and anſwer all the purpoſes of its creation? Is it impoſſible? Does revelation forbid it? I am ſure that 'tis ſo far from it, that the ſcriptures plainly declare the contrary. And it will appear, upon the ſtricteſt and cloſeſt enquiry we can make, into all the brute creation, that they act by ſome principle, equivalent or analogous, to what we call *underſtanding* in ourſelves. If then, by the ſtrength of their underſtanding, they think, reaſon, project, contrive and perform the offices, within their proper ſphere, in a juſt and due proportion, to what we do in ours; they muſt be allowed to have ſome immaterial principle within them. For the ſame uniform effect muſt be produced by the ſame uniform cauſe in both; and what is the terrible conſequence of all this?

As beaſts have underſtanding, ſo they have a language, or method of communicating their knowledge, advice and aſſiſtance to each other. If they could not underſtand or be underſtood by each other, they could neither give nor receive any com-

comfort, aſſiſtance, or help from ſociety; and without ſuch a communication, it would be abſolutely impoſſible for ſuch a ſociety to ſubſiſt. In a word, no more communication, no more ſociety. It is impoſſible that the turtle, that is fond of his mate, ſhould be at a loſs for proper expreſſions to diſcover the tenderneſs, the jealouſy, the anger, the fears, he entertains for her; in the ſeveral incidents of life, that muſt ariſe betwixt the moſt loving couple, in the courſe of a long cohabitation. He muſt ſcold her, when ſhe plays the coquet; he muſt bully the ſparks, that make attempts upon her virtue; he muſt be able to underſtand, when ſhe calls to him, &c. Enter into a wood, where there are a parcel of jays, the firſt that ſees you, gives the alarm to the whole company. Let a cat ſhew herſelf in a garden, the very firſt ſparrow or ſwallow, that perceives her, warns all his companions. Many thouſand examples might be produced to prove that brutes have a power of expreſſing their ideas, and ſentiments, to each other. Is it not offering violence to reaſon, nature, and common ſenſe? Is it not making a mock

of God's creatures? to ſay that they are either animated by evil ſpirits, or that they are mere machines. Sure I am the ſcriptures, and moſt ancient philoſophy, treat this ſubject in a very different manner. Moſes declares that they have living ſouls, Gen. i. 29, 30. On this account it is, that the ſcriptures every where repreſent them, as objects of divine care and compaſſion; as depending upon him for the ſupport and ſuſtenance of that life, which he has given them. Job. xxxiii. 41. Pſal. civ. cxlvii. ver. 9. Mat. vi. 26. Man, in his ſtate of innocence and glory, ſtood in the place of God, to the world below him, cloathed with all the beauties and bleſſings of paradiſe. Thro' him were derived all the bleſsings, of that happy ſtate, to all the different ſpecies, tribes and families of the animal creation. But man, by his fall, forfeited both for himſelf, and them, all the bleſſed privileges of paradiſe; and upon the tranſgreſſion, an univerſal ſentence of condemnation went out againſt the whole ſyſtem. The whole univerſe ſuffered, in every article of its nature, in ſuch a manner, as one would think nothing, but ſome univer-

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ſal guilt, and entire corruption and degeneracy, could poſſibly deſerve ſuch a judgment.

But when Man, by his fall, had interrupted all the ſources and channels of divine communications; he had no bleſſing to receive, therefore none to beſtow. No wonder therefore that the whole ſyſtem of creatures below him, who were his ſubjects, domeſtics and dependants, are deeply affected by his fall; and ſhare in his puniſhments. The whole ſyſtem of the viſible creation ſympathizes, and ſuffers with their rebellious Lord; ſo the Epiſtle to the Romans tells, chap. viii.

The ſtate of the Brute Creation, therefore, has, ever ſince the fall of Man, been very different from what it was at firſt. They are guiltleſs of our tranſgreſſions, and ſhould be the unhappy objects of our care and compaſſion. And it is a breach of natural juſtice, an indication of a cruel and unnatural temper, to abuſe and oppreſs them; to increaſe their miſeries; aggravate the ſufferings of theſe innocent and unhappy creatures;

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and to add, by our barbarity, to the weight of the bondage, to which they are made ſubject, by our diſobedience. The ſcriptures declare it a mark of our duty to be merciful to the cattle. Proverbs xii. 10. And God himſelf guards againſt the cruel oppreſſion of cattle, by the Sabbath days reſt, Exod. xxiii. 12. and in the 4th and 5th verſes mentions particular acts of mercy, that he requires us to perform to them. And our bleſſed Lord mentions it as an act of humanity and natural juſtice, Matt. xii. 10. Luke xiv. 5. And God makes a particular law in favour of the ox that treadeth out the corn. The King of Nineveh, upon the prophet Jonah's denunciation of deſtruction upon it, proclaimed a faſt of three days, for the cattle as well as the people: and God declares his compaſſion for the cattle, as well as for the people.

But if the ſouls of brutes are immaterial, as I ſaid before, then the unavoidable conſequence is, they muſt be immortal; which indeed to ſome will have the appearance of philoſophical hereſy. But let the appearance be what it will, no truth ſhould

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be ſtifled for fear of conſequences (which is too much the caſe with thoſe that would be thought the guardians and tutelar angels of true religion; but their faſt and looſe game let them anſwer for to God, and juſtify it, if they can.) I dare pronounce the ſouls of brutes immortal, from ſcripture, evidence, reaſon, and argument. Pray will you be pleaſed to tell me, what you think was their original ſtate and condition in Paradiſe; when all the works of God were pronounced very good? Were they mortal then? Could any creature be mortal, before death came into the world? But death was the conſequence of tranſgreſſion, Rom. v. 12. If death then was the conſequence of ſin, 'tis abſurd to ſuppoſe that the effect ſhould precede the cauſe; that the execution ſhould both anticipate the ſentence of condemnation, and the tranſgreſſion. Therefore we are led to believe, that, in the intention of their Creator, by their original frame, and their relation to the univerſal ſyſtem, they were to be partakers of that bliſs and immortality, which was the privilege of the whole creation. Till man, by his diſobedience, forfeited it

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for himſelf, and in conſequence for them. Infinite wiſdom created nothing in vain. In the infinite variety of creatures, there was none either ſuperfluous or uſeleſs.—Did not God Almighty intend, even the minuteſt portion of the creation, to be a monument of his infinite wiſdom and goodneſs; by contributing to the beauty, order, and harmony of the whole? then the preſervation of the ſpecies was neceſſary to perpetuate the harmony of the whole. What probable or poſſible reaſons then can be aſſigned, for the deſtruction of the individuals? God's mercies are over all his works. He made them all to be happy, as exquiſitely happy, as infinite goodneſs, wiſdom and power could make them; and their rank and ſtate in nature was capable of receiving. And it is not owing to any mutability in the counſels of God, to any fault of their own, that they have loſt any degree, of that happineſs, they were created to enjoy. But it is the fatal and neceſſary conſequence of the relation, they ſtood in, to their unhappy rebellious Lord; and the dreadful confuſion his diſobedience has brought upon the whole viſible creation.

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Can we think that infinite mercy, who made them to be happy, in the primary intention of their nature, could deprive them of that happineſs, by an utter extinction of their being? To build up and pull down, to create in order to deſtroy, to do and undo, without any apparent neceſſity, is a reflection upon common ſenſe. And ſhall we dare to accuſe infinite wiſdom, goodneſs and power, of an infirmity, which a man of common ſenſe would bluſh to be guilty of? If we were the owners and creators of theſe animals, would we not be anxious to preſerve them? And can we have more regard for our own works, than God has for his? If then we would not wantonly torment and deſtroy any of God's creatures; neither will he put an end to the being of any creature, whom he hath created, capable of eternal happineſs.

Some ſay, their lives were deſigned to be temporary and ſhort. But pray who told any body ſo? where did they learn this philoſophy? what reaſon or religion taught this doctrine? ſure I am it is a contradiction to both. The wiſe Preacher, and the royal

Pſalmiſt, teach us other philoſophy, Eccles. iii. 14. Pſal. 104.

If therefore all the works of God are the effect of infinite wiſdom. If every, even the meanneſt, the ſmalleſt, the moſt contemptible creature, was formed and eſtabliſhed in its proper rank and order, by the unerring counſel and wiſdom of the Almighty. Is it not a bold preſumption to impute to that wiſdom unworthy and contradictory counſels, inconſtancy and mutability? But the Pſalmiſt ſays, that the original purpoſes of God, in their creation, ſhall ſtand for ever and ever. And whatſoever changes, and revolutions, they may undergo; yet they ſhall in due time appear again, in their proper place and order; Pſal. civ. 30.

If they were intended not only to fill up the ſeveral ranks and orders, they ſtand in, in the univerſal ſcale of beings; and compleat the harmony of the univerſe: but alſo to have their ſhare in the general bleſs, and ſuch a degree and portion of happineſs as they were capable of enjoying. Will any one ſay, that it would be no puniſhment to them to be totally deprived

prived of that happineſs, by an extinction of their being. You need not tell me, God may do this or that, by his almighty power, without injuſtice; and as he created, ſo he may deſtroy. This is weak, fooliſh, and ignorant arguing. God's works are founded upon the immutable principles of infinite wiſdom, goodneſs, and truth. Jam. v. 17. Heb. xiii. 8. Therefore the omnipotent and omniſcient creator, who, from eternity, ſaw through all the poſſibilities of being, could not ſee reaſon for creating, at one time, and deſtroying at another time, the works of his own hands.

All the effects of infinite wiſdom were deſigned to anſwer ſome end, to ſerve ſome purpoſe; or they were not. They contributed ſomething, to the beauty and harmony of the whole; or they did not. They were either uſeful and neceſſary, in their ſeveral ranks and orders; or ſuperfluous and uſeleſs. If you ſay, they were made for ſome end, to anſwer ſome purpoſe: that they contributed to the beauty and harmony of the whole; it will neceſſarily follow, that they do ſo ſtill. Unleſs you will venture to ſay, that the ſyſtem is altered; that

what was once neceſſary is not ſo now: which is abſurd and blaſphemous. It therefore follows, that, whatever uſes and purpoſes were intended in their creation; can only be ſupplied and anſwered, by ſtill preſerving them in being. If you ſay, they were not the effects of infinite wiſdom; that they were not made to ſerve any end, or anſwer any purpoſe; that they contributed nothing to the harmony of the ſyſtem; is not this both blaſphemy and nonſenſe? If, therefore, the poor brutes, have no ſin to anſwer for; and would never have known either pain or ſorrow, ſuffering or death; had our firſt parents continued as innocent as they. What then ſhould hinder their continuance in being, after the diſſolution of their bodies? Why may not the immaterial form be diſpoſed of, in its proper ſtate; waiting for the time of the reſtitution of all things, Acts iii. 21. when the whole ſuffering creation ſhall be delivered from the bondage of corruption, into the glorious liberty of the ſons of God. Rom. viii. 21.

Some are at a loſs, how to diſpoſe of them after death: but we need give ourſelves

ſelves no trouble and uneaſineſs about that. God Almighty, that made them, will find out a place for them. Neither need we be afraid; leſt there ſhould not be room in the creation to hold them. Let us truſt God with that, and not trouble our heads about it. What is it to us to know, how they will be diſpoſed of; after the diſſolution of their bodies? Cannot infinite power, which formed them; without our advice and aſſiſtance, diſpoſe of them in the ſame manner? What would have become of the numerous deſcendants of the ſeveral ſpecies of beings, if Adam had not ſinned; and if death had not entered into the world? Can we ſuppoſe, that he, who made them to increaſe and multiply; had not made a proper proviſion for their reception? And will not the ſame wiſdom and power, think you, continue the ſame proviſion for them ſtill? When we obſerve ſuch a wonderful gradation of beauty, form, perfection and proportion, in the ſeveral parts of matter; through the animal, vegitable and mineral kingdoms; through all the ſpecies of foſſils, plants and animals, up to the human body: it muſt appear to a rational and attentive mind, to

be

be a wide and unnatural chaſm in the nature of things; if there were nothing between dead matter, and the human ſoul. Let us not then embarraſs ourſelves, with doubts and enquiries; about the purpoſes and counſels of infinite wiſdom, in the creation of ſuch a wonderful and beautiful variety. But let us ſatisfy ourſelves, that, as nothing leſs than infinite power could produce the leaſt and moſt contemptible creature into being; ſo nothing leſs than infinite wiſdom has formed and directed them, to anſwer the ſeveral purpoſes of their creation; and fill their different ranks and ſtates in the ſcale of beings. And that the ſame infinite wiſdom will not fail to diſpoſe of them hereafter, in the moſt proper manner; to anſwer the original purpoſes of their creation.

The wonderful gradation, in the ſcale of beings, is not only the object of daily experience and admiration; but alſo a noble key, to open to us the more remote and inviſible ſcenes of nature and providence; and to raiſe, upon the foundation of a juſt and proper analogy, a rational ſuperſtructure,

ture, little inferior, in evidence and ſtrength, to a mathematical demonſtration.

As we obſerve, in all parts of the creation, a gradual connection of one with another, without any great or diſcernable gapes between; for the great variety of things, we ſee in the world, are all ſo cloſely linked together, that it is not eaſy to diſcover the bounds between them; ſo we have all the reaſon imaginable to believe, that, by ſuch gentle ſteps, and imperceptible degrees, beings aſcend, in the univerſal ſyſtem, from the loweſt to the higheſt point of perfection. The difference between man and man is inconceivably great. There are ſome that have very little, beſides their ſhape, to diſtinguiſh them from brutes; and one would be almoſt tempted to think them of a different ſpecies. For there is almoſt as great a difference, among individuals of the ſame ſpecies; as between two out of different ſpecies.

That there ſhall be an univerſal reſtitution of all, that fell by Adam's tranſgreſſion; when all that was loſt in the firſt Adam ſhall be renewed in the ſecond. That there ſhall be

a new

a new heaven, and a new earth, which ſhall be the habitation of righteouſneſs; God hath abundantly and plainly promiſed, by the mouth of all his holy prophets; ſince the world began. Acts iii. 19, 20, 21. Iſa. lxv. 17.—lxvi. 22.—2 Pet. iii. 13.—1 Cor. xv. 21, 22.—Rev. xxi. 1.

And if the whole material world ſhall be reſtored to its primitive perfection; if there ſhall be a renovation of the face of the earth; there muſt, of conſequence, be a renovation of all the ſeminal powers of all the various productions of fruits, flowers, animals, and all the different inhabitants of the ſeveral regions of nature; all the diſcord of elements, all the malignity of the creatures, ſhall entirely ceaſe and be done away. All nature ſhall put off the corruption, deformity, darkneſs and confuſion of its preſent ſtate; and be reſtored to the purity, ſplendor and beauty of their firſt creation. As the whole ſyſtem of nature, every part of the vegitable and animal world, were partakers of the original happineſs; ſo they ſhall, with man, in due time, recover their loſt happineſs; and return to their primitive

mitive perfection. The certainty of this grand event is evident from many places of Scripture, as Rom. viii. 19, 20, 21, 22. Then Is. xi. 6, 7, 8, 9, shall be fulfilled, & lxv. 25. And the Prophet Hosea foretells the same, ch. ii. 18. I confess I have dwelt too long upon this subject; but this opens to us such a new scene of wonder and love; which will be the subject of admiration to all eternity; that I could not dismiss it sooner. However, now I shall proceed to consider the nature, manner and consequences of the dependance, influence and connection of the Soul and Body.

CHAP. III.

OF THE NATURE, MANNER, AND CONSEQUENCES OF THE DEPENDANCE, INFLUENCE, AND CONNECTION OF THE SOUL AND BODY.

THE medium, that holds the two diſtinct ſubſtances, ſoul and body, ſo cloſely together; that nothing but death can diſſolve the union; and is the inſtrument of ſenſation; is a ſubtile medium, or animal æther, contained in the nerves. We perceive every nerve of the body is affected with a ſenſe of feeling, and they alone; which is evident, by cutting or dividing a nerve. Immediately the part of the body, where it goes, loſes all ſenſation; though the blood and fluids circulate as before. And as theſe nerves are diſperſed over all the body; ſo every part of the body, we can touch, has a ſenſe of feeling, called *ſenſation*; which the nerves, if ſo and ſo modulated, carry to the ſoul, by means of their contained fluid, called *æther*.

The

The greater branches of the nerves are forty in number; TEN derive their origin from the brain, whoſe fibres make up the fibres of four ſenſes, viz. *hearing*, *ſeeing*, *taſting*, and *ſmelling*. Though, properly ſpeaking, we have but one ſenſe, which is *feeling*. THIRTY pair ariſe from the medulla ſpinalis, &c. and furniſh all the other parts of the body with ſenſation; which would be very acute, and affecting, was it not deadened by a fine carnous *parenchyma*. All objects are let in unto the ſoul, by being applied, or coming into contact with the nerves; by which, their æther receives an impulſe: which, by the collition of their machinulæ, they carry to the common ſenſorium, ſituated in the point, where all the nerves terminate. There the ſoul receives and obſerves the impreſſion, and forms the idea; there matter ends, and thought begins. But that myſterious boundary between the ending of matter, and beginning of ſoul, who can exactly deſcribe or delineate?

WHILE the nerves continue juſtly modulated, and braced, to the ſtandard of nature, the ſoul is at eaſe. But if they are faint,

weary, or any ways diſconcerted, the ſoul immediately perceives it, and feels pain. Were the corporeal organs infinitely more ſubtile, the ſoul's faculties would be infinitely more active, penetrating, and juſt.

By means of this connecting medium, the *animal æther*, the various impreſſions, made on the ſeveral parts of the body, not only by external, but internal cauſes, are tranſmitted to and perceived by the ſoul. When a ſtimulus is applied to the body; it obſtructs the due and regular circulation of the nervous æther; which regurgitates back upon the ſoul, and conveys a perception of pain: which, the ſoul having received, directs a greater flow of the nervous fluid, to the affected place; in order to remove the offending matter. If the obſtruction is great; then, from the nature of obſtruction in all fluids, the nervous æther is more accumulated in that place. And the ſoul, receiving diſagreeable ſenſations from that place, adds its influence likewiſe; by impelling the nervous fluid more forcibly to that part, in order to remove the impediment. The conſequence is, the heart

contracts

contracts more forcibly, and at ſhorter intervals; the circulation is accelerated; whence an increaſed heat and inflammation. If the veſſels, by their convulſive throws, diſengage themſelves of the ſtimulating and offending matter; then the dam is broke down: and the circulating æther, before obſtructed, returns to its regular circulation. Then the ſoul receives no diſagreeable ſenſations; believes its tabernacle in ſafety, and therefore is at eaſe. If the obſtructed matter is not entirely removed; then the ſenſe of pain remains; in proportion to the obſtruction. For pain may be eaſed, and partly removed, without diſlodging the offending matter. Thus, as pain ariſes from a greater flow, and obſtruction of the animal æther, to one particular place, than the laws of circulation admit of; ſo the other ſound parts of the body are, during that time, proportionably deprived of their due quantity. When you put a ſtimulus to another part of the body, you then occaſion a pain in that place; and conſequently a greater flow of animal æther: the conſequence is, a derivation from the part firſt affected, and a mitigation of the inflam-

inflammation; the veſſels contract leſs ſtrongly, and the circulation is not ſo rapid, nor the heat ſo great; and the pain is divided, and thereby diminiſhed. As the ſoul receives diſagreeable ſenſation, from two parts, it bends the nervous fluid equally to both. Thus, you ſee, the ſaying holds good, *divide et impera*; whence we may cure one pain, by inflicting another. And an obſtruction, inflammation, &c. may be removed, by applying a ſtimulus to any other part of the body. Therefore, we ſee the uſe of bliſters, cataplaſms, &c. in curing inflammations, &c. by cauſing a derivation. They are alſo of great uſe, when applied to the inflamed place, in increaſing the oſcillatory motion; and thereby aſſiſting the veſſels to throw off the offending matter, and open the obſtructions. As the involuntary motions of the body are conſtant, uniform, and regular; ſo the ſoul is accuſtomed to them, is unconcerned, and entirely neglectful of them; and leaves matter to act by its own ſtated laws. But the neceſſary conſequence of a ſtimulus, whether the ſoul adverts to it, or not, is a greater flow of the animal æther to the part;

part. For all fluids collect themſelves, in greater quantities about the part, where their current is obſtructed.

The general and wiſe intention, therefore, of all involuntary motions, is to remove every thing; that irritates and diſturbs, or hurts the body. For a ſtimulus is an obſtruction of the nervous æther; and the more it is collected into one place, the more its force is increaſed. Whence thoſe violent motions of the heart, in the beginning of fevers, ſmall-pox, &c.; when frequently the blood, from its being affected by a *myaſma*, acts as a ſtronger ſtimulus than uſual, upon the organs. The beſt things may, by exceſs, become hurtful: ſo this endeavour to free the body, or any of its parts, from what is noxious, is ſometimes ſo ſtrong and vehement; as to threaten the entire deſtruction of the animal fabric.

Quick and inſtantaneous, ſtrong and violent motions, ſeem abſolutely to have determined the nature of the animal æther, to be the moſt quick, active and volatile of all imaginable fluids. Becauſe none elſe is capable

pable of ſo quick and ſtrong actions; in order to determine the inſtantaneous obedience of the muſcles, to the orders of the will. And ſuch ſtrong, violent, and quick motions muſt neceſſarily make a great waſte, and expence of this animal æther; ſo as to require a conſtant ſupply, of ſuch fine and ſubtile parts, from the blood and atmoſphere.

That there may be, in nature, material ſyſtems of fluids, of ſeveral degrees of rarity and ſubtilety, even indefinitely many, appears from the elaſticity, attraction and other qualities of the Newtonian æther: which muſt neceſſarily ariſe from another more ætherial and ſubtile fluid. Or elſe we muſt admit *elaſticity*, *attraction*, &c. in the particles of the Newtonian æther, without a cauſe: or ſuppoſe theſe qualities innate to them; and to have been impreſſed on them, at their firſt creation, by the Almighty. For nature never acts, in general, by ſtarts and jumps, or unequal ſteps. Whence we may infer, that, as in quantity, there is one or more means between the leaſt and the greateſt: ſo, in ſubſtances of all kinds,

there

there may be intermediates, between the mere immaterial ſpirit, and groſs matter; for the original atoms were of different ſizes. And this intermediate material, and extremely ſubtile ſubſtance, makes the cement between the human ſoul and body; and is the inſtrument or medium of all its actions and functions. But of this infinitely fine and elaſtic fluid, I am afraid none will be able to determine the ſpecific nature.

That we may however diſcover, as far as the caſe will admit, the nature and creation of this animal æther, we ſhall conſider the nature and uſe of the ſeveral organs and veſſels of the body, with their contained fluids. The ſtomach, we know, is the firſt veſſel, that receives the food, from the mouth. The food is bulky matter, more or leſs compacted. This matter, being received into the ſtomach, follows its own nature; and, by the heat of that organ, ſoon ferments, and thereby ſtimulates the coats of the ſtomach into convulſive contractions; and theſe contractions, with the aſſiſtance of the attraction and collition

of the particles of food, againſt each other, ſoon turn it into a homogenious fluid ſubſtance, called *chyle*, or matter, one degree refined, having its groſſer parts ſeparated; which, by their ſpecific gravity, deſcend, by the pylorus, into the inteſtines, and come out, by the Anus, in form of excrements. The more ſubtile parts undergo another degree of refinement, by their own inteſtine motion, and the action of the guts; and are then abſorbed, enter the maſs, and undergo another degree of refinement; put on another appearance, and are diſtinguiſhed by the name of *blood*: which, by trituration, has many of its angles rubbed off, and gets a ſtill finer conſiſtence, ſo as to enter the lymphatics; from thence it is abſorbed by the nerves; where it gets the name of *animal æther*, *nervous fluid*, *animal ſpirits*, or the *medium* employed in ſenſation. So that the ſtomach is to the chyle, what the arteries are to the blood; and the arteries are to the blood, what the nerves are to the animal æther.

Now that we may have ſome idea of the ſubtilty of this æther, which ariſes from the

the food; let us conſider the magnitude of a red globule of blood, which, by experiments, is found to be in ſize $\frac{1}{100}$ part of $\frac{1}{100}$ part of an inch; that is, 10,000 of them, put cloſe together, would make a line of a geometrical inch in length. The firſt claſs of lymphatics, called *ſerous* lymphatics, is ſix times leſs than the laſt or ſmalleſt blood-veſſels; conſequently a globule, that can enter a lymphatic of the firſt kind, is ſix times leſs than the ſmalleſt red globule, that is ſix times ſmaller than the ten thouſandth part of an inch; and a lymphatic of the ſecond kind, is ſix times ſmaller than that of the firſt; and ſo on, till you get to the laſt claſs of lymphatics; which is thirty-ſix times ſmaller than that of the firſt; and this ſeries of digreſſion proceeds, till you get to the arteries. And all the lymphatics, that have hitherto been diſcovered, are veins, or veſſels, whoſe diameters grow broader, from a narrow beginning, which muſt have their correſponding arteries, and veſſels, to ſecrete a fluid liquor, to lubricate their coats. The arteries obſerve the ſame ſeries of digreſſion; the laſt claſs being thirty-ſix times ſmaller than

the firſt; and every claſs has its arteries, veins, and obſorbents, to ſecrete a liquid, to keep the canals ſupple; the excrementitious part of which paſſes off by the ſanctorian perſpiration. Now, as there are many claſſes of nerves, differing from one another in ſubtilty; ſo one claſs may ſuffer, while the reſt remain almoſt entire. One claſs may, by any cauſe, be rendered unfit for performing its office; while the other is only impeded in its operations: and, no doubt, this is the cauſe of the gradual decline of the ſenſes.

Some individuals have not originally all the ſeries of ſubdiviſions of the nerves; others have loſt them through time; ſome have not got time to bring them to perfection; while others may have them all, though imperfectly formed in all their ſeries; as we ſee in ſlow capacities, old men, children, and fools.

Matter, therefore, from its being taken into the mouth, till it arrives at the nerves, and goes off by perſpiration, is the ſame individual matter, having only ſuffered this change,

change, of having its parts more finely divided, which does not alter its eſſence. 'Tis matter in the mouth, and matter in the nerves, and both ſubject to the ſame laws. And were we to go, ad infinitum, in dividing matter, the fineſt ſubdiviſion will have all the properties, and be ſubject to all the laws, of the groſſeſt matter; for no change of place, or diviſion, as I have already proved, can work the ſmalleſt change in the eſſence.

This we may illuſtrate by a familiar and obvious example drawn from fire or heat, which is a degree of fire, and may be properly called fire inviſible.

HEAT chiefly conſiſts in the local motion of the ſmall parts of a body, mechanically modified by certain conditions; of which the principal are, the vehement and various agitations of the ſmall inſenſible parts, and that quaquaverſum; for a progreſſive velocity of a body is not ſufficient to create heat; as is evident from the motion of the air or water, which do not grow hotter by motion. For the production of heat, it is neceſſary that

that the parts be exceeding fine and ſubtile, and rapidly agitated, otherwiſe they cannot penetrate the pores of neighbouring bodies, ſo as to warm and burn them. The intenſeneſs of heat is, *cæteris paribus*, as the denſity of the rays, or particles of matter which occaſion it; and the denſity is as the ſquare of the diſtance from the radiating point reciprocally.

Heat is not a fluid, *ſui generis*, which freely pervades all bodies; but only the action of the particles of matter againſt each other. After you have obtained heat, increaſe only the attrition and collition, a little more, and you get fire, or viſible heat; which is nothing elſe, but the particles of matter, by rubbing againſt each other, and thereby loſing many of their angles, become finer, and more diſengaged. So *ſmoak* is the *fumes* ſeparated from any body, by the action of its particles upon each other; and *flame* is ſmoak heated red hot, and agitated violently enough to emit light. As attrition and collition produce fire, ſo does fermentation; which is nothing elſe, but an inteſtine motion of the

the particles of matter *inter ſe*; as I have ſhewn in my *new ſyſtem* of *phyſic*. Take away a little of the velocity of the parts of matter, which produced fire, and you have light; which is only fire, whoſe particles are at too great a diſtance from each other, and too languid in their motion, to be ſo penetrating as to burn. Diminiſh the motion, and ſet the corpuſcles at a ſtill farther diſtance, and you produce æther, or inviſible light; differing only from the nervous æther, as a contained does from an extravaſated fluid. The one is called animal æther, the other plainly æther, or air.

When I ſay, that æther is inviſible, I mean, only with reſpect to man; for it may be viſible to ſome other creatures, as cats, owls, &c. for the corpuſcles or atoms of light have a poſitive exiſtence; and do not loſe their being, with the departure of the ſun; or when darkneſs comes on. For day-light is nothing but æther, put in motion by the ſun's rays; which is to the air, what the ſoul is to the nerves. Whether there is abſolute darkneſs, where no creature can ſee, is more than I know. We, every day, ſee, what

what is darkneſs to one ſpecies of animals, is not ſo to another. And even, in the ſame ſpecies, we obſerve a difference; one individual differing conſiderably from another.

All objects, ſeen by the ſoul, have rays, paſſing through the pupilla, to the retina; where they give an impulſe to the optic nerves; which impulſe raiſes a motion, in the animal æther, concerned in viſion; which illuminates the points of the brain, that go to the formation of the optic nerves, by means of the humours of the eye reflecting all the points of the object upon the retina. And accordingly the ſoul perceives the object, more or leſs diſtinctly, as the humours, more or leſs accurately, reflect the points of the object. Whence we ſee, that, tho' the eye be fitted out with all the geometrical exactneſs poſſible, yet, if the optic nerves are incapable of carrying the reflection from the retina, the ſoul will not perceive the object.

Again, if the humours of the eye are viſcid and languid, then the refraction of the

the rays will be languid, and the ſoul's perception will be dull and imperfect. Films, motes and ſpecks will ſeem to be in the eye; the corpuſcles being languid, will, by their attraction, form into larger ones; which darken the atmoſphere in certain points, and appear to the ſoul as real motes.

On the contrary, if the fibres are too much contracted, and the humours accelerated and divided; then the ſoul will be ſtuned, with the light, and inflammations will ariſe in the eyes.

When the optic nerves are perfect, and the humours of a proper denſity; the ſoul, by acting upon the animal æther, contained in the optic nerves, can recall the remembrance of an object, the idea of which, it has once received by their means, as diſtinctly, as if the object was preſent before it; by putting the nerves and æther into the ſame tenſity and motion, which the object did, when firſt it gave the impulſe.

The ſoul acts from a central point, of ſelf-motion and ſelf-activity, radiate in a limited ſphere: and, where it finds proper organs, concurs and analogiſes, in theſe organs, with the eſtabliſhed laws of bodies.

In order to underſtand this a little more perfectly, we ſhall conſider the nature of the ſun; which is to the earth and atmoſphere, what the ſoul is to the body.

The AIR exiſts in three conditions, *fire*, *light* and *ſpirit*: the light and ſpirit are the finer and groſſer parts of the air in motion. From the earth to the ſun, the air is finer and finer; till it becomes pure light, near the confines of the ſun, and fire in the orb of the ſun or *ſolar focus*. From the earth, towards the circumference of this ſyſtem, including the fixed ſtars; the air becomes groſſer and groſſer, till it becomes torpid and ſtagnates; in which condition it is at the utmoſt verge of this ſyſtem. To this agree the ſcripture expreſſions, *utter darkneſs*, *blackneſs of darkneſs*, in the New Teſtament; and *darkneſs* that may be felt, in the Old.

The

The ſun, which is in the center, is the active vivifying principle; which, by its attrition and collition, reduce the groſſer parts of the atmoſphere into atoms, fine ſubtile parts, or æther; which, iſſuing out in right lines, by means of their concuſſion againſt each other, and the conſtant influx of the groſs fluid from behind, ſets the atmoſphere in motion, which puſhes the earth forward; which is prevented from being puſhed out of its own orbit, by the groſs matter behind. We are not to ſuppoſe that the rays of the ſun reach our earth: their influence indeed reaches, but the rays proceed only a ſhort way from the ſun, which give a ſtimulus to the atmoſphere. Thus this material ſyſtem is perpetually changing conditions, and circulating.

This æther, or ſpirit, is the cement of all bodies, ſupports the creation, and is the cauſe of all the revolutions, changes and motions in the univerſe; the voluntary actions of animals excepted. Withdraw only this, and matter would immediately fall into the original *chaos*, out of which it was

formed. Some think, this was the caſe, at the deluge.

Juſt ſo it is with the heart; it receives its firſt motion from the animal æther, whereby it diſcharges its contained blood; which continues to circulate, by means of the elaſticity of the veſſels, and the ſtimulus it gives to the nerves; till it returns again to the heart.

As the heart is to the blood, ſo the brain is to the nerves. The heart is the center of motion to the blood; and the brain is the center of motion to the nervous æther; and all received motion, at firſt, from the Almighty FIAT.

The ſoul is placed by the Almighty in the ſenſorium of the brain; as a center in a circle; the nerves are radii, proceeding from that center, whoſe axis muſt always be exactly parallel to that point. In this ſituation, they make their impulſes fully, and in direct lines. But if the axis of the radii of any of the ſenſes, is a little aſkew; then that ſenſe, or ſenſes, depend-

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ing upon that radius, or radii, are imperfect, or intirely loſt.

Suppoſe the axis of the radius of the optic nerve, is not parallel to the ſenſorium, but a little aſkew; then viſion is deluſive; we believe objects to be different, from what they are really diſcovered to be, by thoſe whoſe optic nerves proceed in direct lines from the center.

If, by a fall, or other cauſe, the nerves are ſtruck aſkew; then the perſon loſes the uſe of his reaſon: and the ſame ſhock, that deprived one perſon of his reaſon, may recover the uſe of it to another, whoſe nerves were aſkew before; and, by concuſſion, &c. have their axis parallel to the ſenſorium, and the radii come all in direct lines to the center.

So that the difference proceeds, not from the immaterial being; but from the regular or irregular motions of matter; upon which, the exerciſe of the faculties depends. So that, whenever God Almighty is pleaſed to diveſt the ſoul of that clog of fleſh, the

body;

body; it will appear the ſame immaterial, impaſſible being, whether it formerly reſided in the body of a fool or philoſopher; an old man or an infant; a helpleſs, poor invalid; or a healthy, rich, imperious potentate.

What this immaterial ſubſtance is, conſidered in itſelf, diſtinct from the body, we have but a faint and imperfect idea, therefore we muſt turn our eyes to its faculties; the exerciſe of which, while impriſoned in matter (and what its power and manner of operation, when diveſted of matter, is not our preſent buſineſs to conſider) depends upon the modulation and mechaniſm of matter.

The ſoul muſt have an object, and bodily organs, able to receive ſenſation from that object, when applied to them; which impulſe, or ſenſation, is carried to the ſoul, and puts it upon exerciſing that faculty called *perception:* and, by its intrinſic power, it retains or loſes that perception; exerciſes, revolves, or turns it over. The act of the ſoul, in retaining perceptions, is called *memory*. The memory itſelf, or retained perceptions,

ceptions, are the materials that make up or compoſe our *thoughts*; and the exerciſe of the ſoul, in revolving and turning them over, is called *reflection*.

Now the ſoul, being furniſhed with materials, from objects from without, can within itſelf, compare them with one another; and thereby diſcover the agreement or diſagreement, the relation and connection, they bear to one another; and this exerciſe of the ſoul, we call *reaſon*, *wiſdom*, *judgment*, or *underſtanding*; which is always in proportion to the materials, and the fibres of the organs in juſtly conveying them. If the ſoul loſes, at any time, a perception; it muſt act upon the bodily organs, till it brings them, to that degree of tenſion, they were in, when firſt they gave that perception. And if that does not recover it, then, there is an abſolute neceſſity, to have the primary object applied to the organs, to raiſe the ſenſation, before the ſoul recovers the perception. So that, take away objects or render the organs, either not ſuſceptible of impreſſion, or incapable of conveying it to the ſoul, ſo as to excite perception in it;

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you render the ſoul incapable of acting, even ſo much as to ſhew its own exiſtence, by conſciouſneſs.

Yet, though matter properly performs its part, in making impulſes, that raiſe juſt, clear, diſtinct and full perceptions; the ſoul has a faculty, given it by Almighty God, peculiar to itſelf alone, and incompatible with matter; by which it is able, to counteract any or all the perceptions excited, by the impulſe of matter; whenever it pleaſes to exert that faculty, in a proper manner. This faculty we call *will*, which diſtinguiſhes the animal, from the vegitable creation. When the ſoul wills to influence the body, it diſplays its influence upon the animal æther, by contact or colliſion: it affects the nerves of the heart, which conſequently alter its contractions; the heart alters the motion of the blood, and contraction of the arteries; which gives a different beating to the pulſe.

If the ſoul wills to recover, meditate upon, or entertain itſelf with a pleaſant perception, it accelerates the motion of the ani-

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mal æther, which makes the heart contract faſter; the arteries beat quicker; the fluids move with greater velocity; and the pulſe is more rapid and full.

If the ſoul wills to perceive a diſagreeable or frightful idea; it gives a faint impulſe to the animal æther; which conſequently moves ſlower; the fibres of the arteries become lax; the ſecretion of the æther is diminiſhed; the heart contracts ſlowly, and is hardly able to thruſt out the blood; the arteries too beat languidly; the fluids move weakly, and, in ſome parts of the body, ſtagnate; the ſolids are relaxed; and the ſecretions interrupted. This ſhews us why a perſon turns pale, upon a fright: the heart flutters, becauſe it is unable to contract with ſufficient force, to diſengage itſelf of the blood, and to throw it into the arteries; which occaſions the perſon ſometimes to fall into a ſwoon.

The exerciſe and operation of the faculties of the ſoul, depend upon each other, and are tied together, as the links of a chain.

The *underſtanding, reaſon, wiſdom, knowledge or judgment*, is the ſupreme faculty of the ſoul. That faculty depends upon another, called *memory* or *retention*; which ariſes from a third, called *reflection* or *thought*; and thoughts ariſes from *perception*; and perception comes by *ſenſation*, conveyed to the ſoul. And the ſenſations are excited, by the application or impreſſion of objects upon the organs of ſenſe, or at leaſt to the medium of ſubtile æther, that ſurrounds them. That is, material objects can act, no other way, upon the animal organs, but either immediately, by communicating motion to theſe organs, and thereby putting their conſtituent parts, into action and reaction, upon each other; or mediately, by the intervention of ſome ſubtile fluid or matter, upon which they impreſs their actions and motions; which is tranſmitted, in the ſame manner, by the medium, to the organs. Small bodies act upon one another in the ſame manner, and by the ſame laws and mechaniſm, as great bodies do.

He, who would underſtand the effects of little bodies, and the action of their particles upon

upon each other, has nothing to do, but reſemble ſmall bodies to great ones, under particular laws and conditions. For example; as attraction is the ſame in ſmall bodies as in large; we ſee that bodies of plain and ſmooth ſurfaces, in which many points come into contact, cohere moſt ſtrongly; which neceſſarily follows from the principle of attraction. For attraction is nothing elſe but a certain determinate connection and figure of atoms, which fit them to be more or leſs acted upon by the preſſure of the atmoſphere.

The organs or inſtruments made uſe of, by the ſoul, and deſigned by God Almighty to convey ſenſation to it, are the five ſenſes, viz. *hearing*, *ſeeing*, *taſting*, *ſmelling*, *and feeling*; other inlets the ſoul hath not. It ſees through the eyes, and through them alone; hears through the ears, and only by their means, &c. The ſoul cannot from any will or power of its own, make one ſenſe perform another's office. If you ſhut the eyes and put any object to the ear, the ſoul does not, from the application, perceive its figure, dimenſion or colour; but when you open the eyes, and apply it there, the ſoul

immediately perceives the figure, dimenſion and colour of the object; if there is not a defect in the optic nerve.

The ſoul, as I obſerved before, has, by means of its ſupreme faculty the *will*, a power in a regular *ſyſtem* of *organs*, of intending or remitting the circulation of the blood, by contracting or relaxing the fibres or ſolids, upon which the circulation greatly depends: conſequently can impede or accelerate the motion of the nerves, and thereby neglect, attend to, loſe or improve the ideas, conveyed by them. The attention to particular ideas, like motion to the body, reſtores the nerves or preſerves them, to a particular tenſity; whereby the ſoul has more time to judge of objects, with greater exactneſs. And this capacity of judging, is acquired, by ſtudy and application.

Seeing, therefore, the ſoul has a power to contemplate any of its ideas; it will naturally entertain and often reflect upon thoſe, that give it moſt pleaſure; which ſurely, in the pure ſtate of man in Paradiſe, were the moſt elevated and refined: and nothing being ſo

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ſublime as the adoration of God, and contemplation of his works of creation; the chief employment of the Paradice inhabitants, therefore, was to worſhip God, and view the operations of his hands. For man's body, before the fall, allowed the faculties of the ſoul to diſcover the moſt ſecret and hidden properties of material objects, and the relation they bore to one another, and the reſt of the univerſe. But the fall of man wrought the woeful change which we now feel. Thus the God of nature hath formed us, and ordained that the material ſhould obey the direction of the immaterial part, and vice verſa. Thus the ſoul moves or affects matter, and matter the ſoul; and this mechanical ſyſtem of matter and ſpirit conſtitute that organized machine called body; which is preſerved in life and health from the harmony of its ſeveral parts; for it is well known that a diſordered body will occaſion a diſordered mind, et vice verſa.

SECT. II.

CHAP. I.

OF MAN, CONSIDERED AS ENJOYING THREE KINDS OF LIFE, VIZ. A VEGITABLE, ANIMAL, AND SPIRITUAL.

THE VEGITATION OF PLANTS, MINERALS AND ANIMALS.

THUS I have ſhewn that man is made up of two parts, matter and ſpirit, or body and ſoul, and that the different affections of matter and motion, differently modulate the action of the ſoul, which is limited and dependent upon the regular influence of organized matter; as alſo that the ſoul is capable of producing diverſe thoughts and motions in a ſyſtem of matter, whoſe corpuſcles are properly arrainged and modulated, to be directed and influenced by its impulſe. The ſoul accompanies the body, through all its different changes, and its relation, to time, place and other circumſtances,

ces, depends intirely upon its being incloſed in matter. However, you are not to ſuppoſe that I mean to deprive the body of a power of acting without the immediate aſſiſtance of the ſoul; no, the body can digeſt the food, and turn it into chyle and nouriſhment, without the aſſiſtance of reaſon, thought or reflection; as long as the body preſerves its juſt balance, equilibrium, or ſtandard of health: but if that is impaired, body and ſoul ſuffer with it. For man is endowed with three lives, viz. *a vegitable*, *animal* and *ſpiritual*: and in this three-fold ſtate we will now conſider him.

Man lives as a vegitable; and, by the laws of vegitation, all his involuntary motions are performed. Let us then conſider vegitation.

By many and repeated experiments, it appears, that, tubes, immerſed in liquors, have a power of attracting fluids, to a certain height; in the inverſe ratio of their diameters: one may be ſatisfied of this by cutting the branch of a tree, and immerſing it in water; he will find the water to aſcend a conſiderable height.

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It is, by the attractive power, with which the ſmall veſſels of vegitables are endowed, that, like ſo many filters, they draw out of the earth, juices differing according to the different natures of the vegitables, and in proportion to their bulk. And the plant is more or leſs nouriſhed and augmented, in proportion, as the water, in which it ſtands, contains a greater or ſmaller quantity of proper terreſtrial matter in it.

Every kind of vegitable requires a particular and ſpecific matter, for its formation and nouriſhment; yea, every part of the ſame plant doeth ſo. For very many and different ingredients go to the compoſition of one individual plant. If therefore the ſoil, in which any vegitable or ſeed is planted, contains all or moſt of the proper ingredients, and thoſe in a due quantity; it will grow and thrive. But, if there be not ſo many corpuſcles, as are neceſſary for the conſtitution of the main and eſſential parts of the plant; it will not proſper at all. Or if the corpuſcles be not in ſufficient plenty, then the plant will be ſtaved, and never arrive at its natural ſtature. And if there be

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any of the leſs neceſſary corpuſcles wanting, there will be ſome failure in the plant: it will be deficient in taſte, ſmell, colour or virtues. And though a tract of land may happen not to contain matter, proper for the conſtruction of one particular kind of plant, yet it may of another. For, it is impoſſible to imagine, that one uniform homogenious matter, having its principles or organical parts all of the ſame ſubſtance, conſtitution, magnitude, figure and gravity, ſhould ever conſtitute bodies, ſo egregiouſly unlike in all theſe reſpects, as vegitables of different kinds; nay, as the different parts of the ſame vegitable are: that one ſhould carry a milky, another a yellow, a third a red juice, in its veins; one afford a fragrant, another an offenſive ſmell; one a ſweet, another a bitter acrid taſte; one nouriſhing, another poiſonous; one purging, another aſtringent; one rough, another ſmooth: and all ariſe from the very ſame matter, is paſt belief. As, therefore, every ſort of grain takes forth the particular matter, that is proper for its own nouriſhment; Therefore we ſee the great uſe of adapting the grain

to the ſoil; and the advantage of frequently changing the ſeed.

The apothecary alſo may ſee, how careful he ought to be, in knowing the proper ſeaſon of the year, and the time of the day for gathering plants; as alſo the ſoil in which they grow, in greateſt perfection. Neither is it a matter of indifference, whether we uſe the flower or the ſeed; the ſtalk or the root; for they are all materially different, in every individual plant.

From all this we conclude, that water is ſo far from being the matter that compoſes vegitable bodies; that it ſerves for little more than a vehicle to the terreſtrial matter, which forms vegitables. Whence we ſee the cauſe of the different ſecretions in the human body.

But water has no power to move itſelf; nor riſe to the vaſt height it doth, in the tall plants: ſo far from it, that it doth not appear, that even its fluidity conſiſts in the inteſtine motion of its parts; for there is no need

need of any thing more to conſtitute the phæ-nomenon of fluidity, than ſuch a figure and diſpoſition of parts as water has: corpuſcles of that make that are abſolutely ſpherical, muſt ſtand ſo ſlippery upon each other, as to be ſuſceptible of every touch: and tho' not perpetually in motion, yet muſt be very ready and capable to be put in motion by the ſlighteſt force imaginable. But by the attraction of the abſorbents, and by their vibrating motions, the ſap continues to aſcend in the veſſels of trees; even in the cold ſeaſon of winter, though ſlowly and in ſmall quantity: and trees, in cold, cloudy weather, provided it be dry, take up continually by the roots, as much moiſture, as is neceſſary to ſupply the waſte by perſpiration, and keep the veſſels of the trunk and large branches full. But though this capillary attraction and oſcillatory vibration make the ſap riſe in plants; they will not, without the aſſiſtance of ſome other cauſe, make a continued derivation of it from their roots, to the branches and leaves: becauſe, as ſoon as the capillary tubes are filled, or have raiſed fluids, to a certain height, all motion from attraction ceaſes; but as the action of the

air and ſun-beams, upon the trunks, branches and leaves, occaſion a ſtrong perſpiration of the ſap, by their pores; a proportional quantity will be attracted from the earth, by their roots, to ſupply this waſte, and keep the cappillary veſſels always full.

However, as often as the abſence of the ſun, and the cool moiſt ſtate of the air, put a ſtop to the perſpiration of vegitables, the ſap ceaſes to aſcend, which occaſions the fall of the leaves of trees; nay ſome affirm that, if the earth be warm and dry, it takes a retrograde motion: and hence they ſay that in a cool ſummer's evening, when the dew begins to fall, vegitables attract the watery particles in the air, by the pores of their leaves and branches; in like manner, as they had done the moiſture by their roots in the day time: and the veſſels that perſpire in the heat of the day, aſſume a contrary office in the night ſeaſon; and imbibe the dew and watery particles then floating in the air. This doctrine, I believe, will be found erroneous: for the veſſels, that receive the ſap from the roots, have valves, that open upwards, and ſhut downwards; ſo that the dew

dew cannot deſcend into them; but they have their veins, which receive the ſap from them, and carry it downwards to their roots: for the roots are to vegitables, what the heart and *primæ viæ* are to the body, of an animal.

The branches and trunks of vegitables, have both their inhaling and exhaling veſſels: by the firſt they receive the dew and moiſture of the air, together with a part of the æther; which is abſolutely neceſſary: as is evident from an experiment of Mr. Ray's, who ſowed lettice ſeed on ſome earth, in the open air; and ſome of the ſame ſeed on earth in an exhauſted air pump: the ſeeds, ſown in the open air, grew an inch and a half in eight days; but that, in the exhauſted receiver, grew not at all; but when the air was let in, the ſeeds grew two or three inches in the ſpace of a week. Hence we may conclude the neceſſity of the air, for the birth, life and continuance of motion of vegitables.

The trunk of a tree or plant is no other than a canal, made up of leſſer pipes, through which the juices circulate; and by the action

tion of the atmoſphere, and the heat, and attraction of the ſun, they are forced from a larger to a narrower ſpace. Air ſo much promotes vegitation, that ſome roots and plants will increaſe, if hung in the open air, without the help of earth; and many vegitables live long, and even grow to a vaſt ſize, in water, without robbing the earth of much of its treaſures. Beſides what the air adds to the real ſubſtance of the plant, it ſhakes and agitates it; and by that means acts as a ſtimulus, makes the juices aſcend, and prevents the ſecretory veſſels from being obſtructed.

By the exhaling veſſels, they perſpire a great deal: indeed the much greater part of the fluid maſs, conveyed into plants, by abſorption, doth not ſettle and abide there; but paſſes through the pores, is thrown out in perſpiration, and exhaled up into the atmoſphere. Perhaps not above the hundred part goes to the addition of the plant; and the detachment, of watery particles, in ſo great plenty, from the parts of plants, affords a manifeſt reaſon, why thoſe countries, which abound with trees, and large vegitables, are very

very obnoxious to damps, great humidity in the air, and more frequent rains, than other countries that are more open and free. What is too groſs and weighty, to be ſupported by the atmoſphere, is depoſited on the ſurface of the flowers, leaves and other parts of the plants; and conſtitute *manna*, *honey* and other gummy exudations, which may be called the excrementitious matter of vegitables: the finer part goes off with the watery, and is, by the air, conveyed to our organs of ſmelling; and are either pleaſant or offenſive; beneficial or hurtful; according to their quality and quantity.

But, though I mention the vegitation of plants, as coming neareſt to that of man; yet I would not be underſtood to exclude the vegitation of minerals, ſtones, &c.

That ſome of the hardeſt ſtones and marbles, at this day, found in the bowels of the earth, were once ſoft, like mud; and capable of receiving heterogeneous bodies into their compoſitions, is, I think, plain to a demonſtration; from the frequent mixture of various ſhells, fiſh bones, bits of plants, and animals,

plants

plants compleatly formed, entire animals (ſometimes alive) found in the hardeſt parts of their ſubſtances

The veins of metals, forming themſelves between the rocks and different ſtrata of earths, like branches of trees, incline one to believe, that they really grow like plants; and receive increaſe from exſudations, and the minute and looſe parts of mineral matter, gradually adhering to their outward ſubſtances.

It is true the progreſs of nature, in this ſort, of vegitation is ſo ſlow, that five or ſix hundred years, and perhaps as many thouſands will give no great proof or certain indication of the increaſe of minerals; but if they grow and vegitate, there is no neceſſity that the time of their growth ſhould be limited, to ſuch periods, as we are wont to aſſign to other vegitables: we may go back, as many thouſand years beyond the Moſaic creation, as the neceſſities of nature may be thought to require: for the beginning of time, of days and years reſpect only the inhabitants of this world. When Moſes ſays, that God

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made this world in ſix days, why may we not be allowed to ſuppoſe it 6000 years, if the obſerved progreſs of nature requires it? For the Scripture tells us that a 1000 years, with the Lord, are as one day.

If the creation of the world was a work of ſix thouſand years, and God reſted the ſeventh; then perhaps it will be of ſix thouſand years duration, and then Chriſt will reſt one thouſand years with his ſaints, before their conſummation in bliſs.

Iron, lead, copper, ſilver, rocks, &c. grow, no more, in a thouſand years, than an oak doth in one year; and this may be ſtill called growing. Though their ſubſtances be bulky, and their veins far extended, yet, ſince we are not bounded by years nor time, in our imaginations, we have ſtill room left in our minds to proportion the one to the other; becauſe whatever alterations, the outward ſurface of the earth may have ſuffered, and undergone, we have no great reaſon to think that the inward parts have been much changed.

Having now conſidered the vegitation of plants, &c. we come now to conſider the vegitable life of man.

The muſcular fibres of animals, are ſo framed, as to contract, whenever a cauſe, proper to excite their action, is applied to them; or, in defect of this, always to remain at reſt. This cauſe is either an effect of the will, or a ſtimulus of ſome kind or other; to the former is owing the voluntary motion, peculiar to animals; to the latter, the vital, ſpontaneous, or involuntary; which all vegitables poſſeſs; and is performed in infants, ideots, and brutes, of the loweſt order, in as perfect a manner, as in the wiſeſt philoſopher.

In DEGLUTITION, the contraction of the muſcles, which pull up the *larynx* and *os hyoides*, and ſo puſh the meat into the dilated *pharynx*, is generally ſpontaneous; it is owing to the irritation of the *fauces*, by the food paſſing this way. No ſooner is the aliment received into the *pharynx*, than it contracts; and, embracing it cloſely, puſhes it on to the *æſophagus*; which, having its nerves irritated, and its fibres ſtretched by the food, in its deſcent, makes each ringlet of this tube contract itſelf, and ſo tranſmit the food to the next, till at laſt it

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is puſhed into the ſtomach; which, being irritated by the ſtimulus and dilatation of the fermenting aliment, contracts itſelf; by which means, it diſcharges, by the *pylorus*, into the guts, part of its contents; then its fibres are ſomewhat relaxed; till the remaining part of the aliment, by its continuing in a fermenting ſtate, ſwells, and thereby dilates and *irritates* the coats of the ſtomach, *into* freſh contractions; ſo that the aliment is thrown into the guts, by the alternate contractions of the ſtomach, excited thereto by a ſtimulus; juſt in the ſame manner as the heart throws the blood into the arteries. The diaſtole of the ſtomach anſwers to the ſyſtole of the guts. Graniverous birds, whoſe ſtomach, are leſs ſenſible of a ſtimulus, ſwallow ſmall ſtones, to break and grind their food, and to excite their ſtomachs into contraction.

When any thing is received into the ſtomach. which ſtrongly irritates, or diſagreeably affects its nerves; it is thrown into convulſive contractions; which are renewed, after ſhort intervals, till the offending

matter is either quite expelled, or greatly weakened.

On the other hand, *opium*, which renders our fibres and nerves inſenſible of any irritation, has, of all other things, the greateſt power to quiet convulſive and irregular motions of the nerves.

The PERISTALTIC MOTION of the guts, is owing to the chyle, bile, and rarified air, acting upon them, as a ſtimulus; the valves detain the aliment, till they occaſion a ſufficient tumeſcence, whereby the part is ſtimulated into contractions; and the aliment is thereby diſcharged into the next portion; ſo that every portion of the guts, between the valves, acts as a little ſtomach or an heart.

Purgatives act chiefly, by vellicating the inſide of the guts, whereby they greatly increaſe this motion; and ſuch things, as render our nerves leſs ſenſible of any irritation, leſſen or deſtroy the periſtaltic motion of the guts. The ſtimulus of the bile, is very neceſſary to the right perform-

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ance of the motion; without it, the guts would not be able to overcome the reſiſtance of the diſtending force of the rarified air, and fermenting, or rather putrifying chyle; their coats would be relaxed, their tone impaired; and their cavities inflated: hence coſtiveneſs, and myaſma ariſing from the excrements, remaining longer in the inteſtines, than, by the laws nature, they ought: this we ſee in an inveterate jaundice, where the bile is obſtructed.

While the chyle is taken up, as it paſſes along, by the abſorbent veins of the ſmall guts; the groſſer and leſs nutritious parts of our aliments are tranſmitted from the *ileum*, by the valve of the *colon*, into the great guts; where they remain for ſome time, without giving any diſturbance; till, by the preſſure of the diaphragm, and abdominal muſcles, in reſpiration, together with the gentle contractions of the guts themſelves, they are puſhed into the *rectum*; where, partly by their acrimony, but chiefly by their weight and bulk, overſtretching the fibres, they excite this gut

tion

into ſtrong contractions, and bring on an inſuperable deſire of emptying it. The more acrid the matter is, the more ſtrongly it ſollicits the fibres of the *rectum* to contraction and ejection; if any acrid matter is lodged in the *plicæ* of the *rectum*, it irritates its nervous *papillæ* as in a *tenaſmus*; and its muſcular coat is excited into frequent, and ſtrong contractions; and there is almoſt a perpetual deſire to go to ſtool. This is beſt cured, by oily and mucilaginous glyſters, with opium.

As I have already, in my *new ſyſtem of phyſic*, taken notice of the manner of the blood's circulation through the body, from the heart, and ſhewn it to be an involuntary, vegitable motion, ariſing from the eſtabliſhed laws of matter; I ſhall now conſider the nature of reſpiration.

RESPIRATION is owing both to the blood's acting as a ſtimulus on the veſſels of the lungs; and alſo to the operation of the air in inſpiration.

Thus we obſerve, that as the blood flows in greater or leſs quantity, through the

lungs,

lungs, inſpiration and expiration more frequently ſucceed each other; whence the quick breathing, obſerved in acute fevers, or upon violent exerciſe. Though the quantity of blood, flowing through the lungs, remains the ſame; yet if its heat, and conſequently its bulk be increaſed, reſpiration becomes more frequent.

When any obſtruction happens in the pulmonary veſſels, which renders the paſſage of the blood through them more difficult, than in health; reſpiration is more laborious, and more frequently repeated: whence the quick breathing in perepneumonies, and other diſorders of obſtructed lungs.

If a portion of the lungs is rendered uſeleſs, or wholly conſumed by an ulcer; then the perſon is ſhort-breathed, and ſubject to aſthmatic fits, upon the leaſt fatigue, or upon any increaſe of the motion, or rarefaction of the blood.

Therefore it appears, that the motion of reſpiration, is always proportional to the quantity

quantity of blood, thrown into the pulmonary veſſels, and its eaſy tranſit through them. Hence we ſee, why blood-letting gives more ſpeedy relief, in fits of difficult breathing, than any other remedy.

Reſpiration differs from other involuntary motions, in this, that the ſoul has a more immediate power over it. The ſoul has, indeed, a power over all the motions of the body; the voluntary motions are the reſult of its action; and the involuntary may be accelerated or retarded thereby. The ſoul, however, is not a party concerned, in the involuntary motions of the body, unleſs called upon, by ſome preternatural ſtimulus.

Digeſtion, circulation, and reſpiration, we ſee, are the reſult of a ſtimulus upon the nerves; and is properly called vegitable, or rather material life. And all vegitables, properly ſo called, foſſils, minerals, &c. have a circulation of this kind; and, as ſuch, the *animalcule* lives in *ſemine*. Theſe were at firſt the productions of nature; and God Almighty ſtill leaves them

them to be governed by the laws of matter.

In one ſenſe, God is the Creator of all things, but nothing immediately are the works of his creation, but the heaven and the earth; that is, the chaos, out of which they ſprung; and all ſpiritual ſubſtances. Indeed, both the ſoul and body of man, were of the Almighty's immediate creation: all other things, (fowls, fiſhes, and all other things that breathe the breath of life, excepted) plants, minerals, foſſils, &c. are the production of matter, and entirely live by mechaniſm: but, of theſe, God Almighty, in a ſecondary ſenſe, is the Creator.

This doctrine may be eaſily proved, from the hiſtory of the creation, by Moſes; the immaterial part of all animals, from what has been ſaid, come immediately from the hands of the Almighty, and is infuſed into the body at birth; till then, the creature lives as any other vegitable.

As ſuch, the animalcule lives in ſemene patris; its circulation is kept up, by means of its ſtimulating fluid, and the heat of the body of the male, which gives it an additional ſtimulus. In coition, when it is lodged in *utero*, the heat of that veſſel, and the ſurrounding waters, act as an aſſiſting ſtimulus, to keep up the circulation. When it is removed from theſe, at birth, it receives part of the ſurrounding air, which ſets its lungs to play; and it has, at the ſame time, that *immaterial ſomething* infuſed into it; which acts upon the nerves, and again ſets all in motion; which continue to move by a ſtimulus, without the will or knowledge of the immaterial part, till death. This I call a material life, common to all the univerſe. Living creatures partake of this life, in common with all other parts of the creation.

Before I leave this part, I ſhall make one remark.

The *fœtus* lives in *utero matris*, without reſpiration, becauſe, the greateſt part of the blood, by means of the *foramen ovale et ductus arterioſus*, is conveyed from the

the right *ſinus venoſus* and *ventricle* of the heart, into the left *ventricle* and *aorta*, without paſſing thro' the lungs; and its fluids, being derived from the mother's blood, which have ſuſtained the action of the air, in her lungs, muſt be equally fit for its nouriſhment and ſupport, as for hers.

The *fœtus*, after ſeparation from the mother, being *involved* in its *ſecundines*, lives for a conſiderable time, without breathing; becauſe the circulation of the blood continues to be carried on, in the ſame manner as when it was in the womb; only a ſmall portion of it paſſes through the lungs. So there is nothing to hinder the animal from continuing to live, till its life is extinguiſhed by cold, or want of nouriſhment. Therefore, children may be alive ſome time after birth, without diſcovering ſigns of life; and we ought not, too haſtily, to pronounce them dead, as I am afraid is too often the caſe.

Many children, I verily believe, are declared to be *ſtill-born*, that were alive and might have remained ſo, if proper means had been uſed, for continuing life. When

the child is much ſtuffed up with phlegm, and is of a cold and heavy temperament; then the reſpiration begins ſlowly, and with difficulty: therefore proper ſtimulants ought to be applied, as blowing into the mouth, friction, heat, moiſtening the noſe and breaſt, with ſpirit of wine or brandy, whipping the child till it cries, &c.

AGAIN, the urinary bladder is a hollow ſolitary muſcle, containing the urine; which gradually oozes into its cavity, from the ureters, and prevents its natural tendency to contract itſelf, into its ſmalleſt capacity; where the urine is in ſuch a quantity, as to over ſtretch the coats of the bladder; then it excites them into ſtrong contractions, which, with the aſſiſtance of the *diaphragm*, *abdominal muſcles*, and *levatores ani*, open the ſphincter, and expel the urine. The contraction of the bladder in a healthy perſon is more owing to its muſcles being over ſtretched, than to any acrimony in the urine; but if the mucus, which defends the nerves, from the acrimony of the urine, is abraded and carried away; or if the inner coat of the bladder is inflamed;

then

then the urine no ſooner oozes through the ureters, and reaches the cavity of the bladder, than it brings the bladder, diaphragm, and abdominal muſcles, into convulſive contractions: whence a painful and conſtant inclination to make water, though it comes away *guttatim*.

At the age of *puberty*, the ſemen begins to be duly prepared: the ſeminal veſſels are dilated, and the ſemen ſtimulates the nerves of the *teſtes and veſiculæ ſeminales*; but when, applied to the nerves, of any other part of the body, does not titulate them: for the nerves of different organs, in the ſame animal, are ſo conſtituted, as to be very differently affected, even by the ſame things. The ſtimulus of ſeed cauſe a more than ordinary flow of the nervous fluid to the *penis*; which gently irritates it into more frequent vibratory contractions; whereby the circulation is accelerated; the heat increaſed; and the *penis*, at length, is thrown into convulſions; which produce an erection; and if this is ſtrong, or long cotinued; it extends its influence over all the body: the pulſe riſes, nay flutters, as in an extacy;

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a glowing heat diffuſes itſelf over all the body; the eyes ſparkle; and the violent titulation of the ſemen, gives a ſtimulus to the ſpermatic veſſels; which, with the ſtrong circulation in the *penis*, impoſe upon the perſon, ſtrong ſolicitations for copulation: when the cauſe ceaſes, the inclination ſubſides.

The erection of the *penis*, frequently ariſes from the bladders being full of urine; and a diſcharge of very acrid, bilious matter by the anus, will do the ſame. In coition, the ſemen is forced down, by the contraction, and convulſive motions of the *veſiculæ ſeminales*; ariſing from the ſtimulating ſeed, into the bulbous part of the *urethra:* then the *muſculi acceleratores urinæ* are thrown into convulſive motions, till all the ſeed is expelled; and by the titulation of the *rugæ* of the *vagina*, in time of coition, not only the uterus is affected, but the *fallopian tubes* turn their mouths to the *ovaria*; till the ovum has paſſed through the coats of the ovarium, into its cavity, through which it is preſſed onward to the *uterus*, by the contraction of the muſcular coat of the tube,

tube, excited by the ſtimulus of the ovum: ſo that every ſmall ringlet of it, by its contraction, tranſmits the ovum to the ſucceeding one; till it drops into the womb: in the ſame manner as the food is conveyed from the mouth through the æſophagus, into the ſtomach.

Infants and children are incapable of luſt; becauſe the ſeminal veſſels are not unfolded. But as ſoon as they arrive at the age, when they begin to unfold, the juices drill down the ſpermatic arteries, and being ſecreted, by the teſtes, produce a new ſenſation, unknown to the ſoul before; which raiſes the perception in it we call luſt: nor is it poſſible to extinguiſh that perception, while the cauſe continues.

But if, through age, the ſpermatic fluid is dried up, then there is no ſtimulus to raiſe the perception; and conſequently no luſt. In bilious habits, where that fluid is plentifully ſecreted, if there is an object, that naturally raiſes that ſtimulus, and if the ſoul co-operates, in aſſiſting the ſecretion.

Luſt

Luſt then has wonderful effects. The blood boils; the pulſe flutters; the fluids, by their rapid motion and attrition, raiſe a temporary fever; the imagination is raviſhed with tranſport. But if the ſoul ſets itſelf to counter-act the other two; by perſevering in the conflict, it, with difficulty, gets the victory; or, at leaſt, the rational management. If they get a head; they will be able to overbear the nobleſt faculties of the ſoul: and if too much followed, will relax the animal æther, and ſet its particles, at ſuch a diſtance, from one another, as never after to be able to return to the former ſtandard; and from a hot, bilious and lively conſtitution, the perſon will become cold, frigid and dull. For paſſions are nothing elſe but a conflict, between the fibres of the nerves, the animal æther, and the operation of the ſoul.

CHAP. II.

OF THE ANIMAL LIFE OF MAN.

FROM what hath been ſaid we ſee that the involuntary motions of animal ariſe from mere mechaniſm; common to them, with the other parts of the creation; and conſtitute the vegitable or material life of animals.

But man, in common with all other creatures, has an immmaterial principle, the SOUL; by means of which he enjoys an animal life; which conſiſts of voluntary motion; and as our involuntary motion depends upon a ſtimulus, applied to the nerves by a material agent; ſo our voluntary motion depends upon a ſtimulus given to the nerves, from an immaterial agent the *ſoul*. So that the nerves are the inſtruments made uſe of, for both motions.

Peoples talking, walking &c. in their ſleep, is no argument againſt their actions being voluntary, and ariſing purely from the ope-

ration of the ſoul upon the nerves. The reaſon of the ſoul's performing theſe actions, when aſleep, is, becauſe the organs, that firſt conveyed theſe ſenſations to the ſoul, remain in the ſame terſion, as when firſt they received the ſtimulus; and are kept in that poſture, by the ſoul's reſting and lodging upon the idea; becauſe it gives it ſo much pleaſure or pain, that it cannot think of parting with it, though the reſt of the ſenſes are ſo relaxed, as to be unfit to be acted upon: therefore, the perſon neither ſees, hears, taſtes, nor feels; though he talks and walks. The muſcles only appropriated to talking and walking, are kept by the will of the ſoul, in the ſame condition, as when they firſt received the impreſſion; ſo it is with the other ſenſes, as hearing, ſeeing, &c. Hence we ſee, that one ſenſe may be fit for receiving the operation of the ſoul, while the others are not. This enables us to account for a perſon's not ſeeing an object, placed before his eyes; not hearing a perſon ſpeak, when he is intenſely looking upon a thing.

The ſoul, as king of the body, may alter and interrupt the involuntary motions.

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The remembrance of laſcivious objects will cauſe a more than ordinary flow of the nervous fluid to the *penis*. The remembrance or idea of things formerly applied to the body, produces almoſt the ſame effect, as if really preſent.

Thus the ſight, or remembrance of grateful food, cauſes an uncommon flow of ſpittle into the mouth of an hungry perſon. The ſight of a medicine, that often provoked vomiting, nay the very mention of its name, in ſome delicate conſtitutions, will raiſe a nauſea; and they are affected much in the ſame manner, when they behold any one, under the violent operation of an emetic. Fear cauſes a diſcharge, by urine or ſtool. Looking much at one that ſquints, affects the ſpectator, with the ſame diſeaſe. Certain diſagreeable ſounds will make the mouth to water. A ſudden fear will occaſion a palpitation of the heart. Yawning will go thro' a whole company. *Leſlie* ſays, that many perſons, from ſeeing the Quakers and other enthuſiaſts agitated and convulſed in their epileptic fits, have fallen into the ſame fits. Certain ideas and thoughts occaſion a flow

of tears, from the lachrymal veſſels. Agreeable ideas increaſe, and diſagreeable ideas retard the circulation of the blood. Whence we ſee the danger, of bringing diſagreeable news, to a ſick perſon, and ſometimes even very agreeable news proves hurtful; alſo how much a ſick perſon ſhould endeavour to keep out of his mind diſagreeable, painful, and afflicting thoughts: therefore a little agreeable company is medicine to a ſick perſon.

Though the ſoul has a power over the involuntary motions of the body, in healthy ſtate; yet when the body is diſeaſed or imperfectly formed, the operation of the ſoul then is irregular.

The organs of the body may be entirely unfit, to be acted upon, by the ſoul; then it remains wrapped up in itſelf, like a criminal in a dungeon. Some people are born with imperfect nerves, which are ſtopt up; and never, all their lives, unfold themſelves, and ſhake of the clog of matter, which obſtructs them. Accordingly they continue ideots all their days; though their ſouls all the while,

are

are equal to Sir Iſaac Newton's; and are only deprived of proper organs to exerciſe their faculties upon: and if by art or accident, the obſtructed avenues, to their ſouls, are opened; they immediately diſplay their faculties; and the perſons juſt before ideots, now become rational men. Whence we are able to account for the vaſt variety we find in mens natural capacities and endowments; which ariſes from this natural difference of the ſtructure, mechaniſm and modulation of the organs of ſenſation. For thought and reflection, which is nothing elſe but thought, returning upon itſelf, bears the ſame relation to the ſoul, as motion does to matter. The ſoul may exiſt, with a capacity of thinking, though it don't exerciſe that capacity; as that depends upon certain given circumſtances. For the ſoul, no more, ceaſes to exiſt, when it does not think, than matter ceaſes to be matter, when it is not in motion. Again the body could often walk, when the ſoul is unable to direct walking; through an indiſpoſition of an animal æther. For it is in vain, that the ſoul wills motion, when the nerves are palſical, relaxed, unfit and unable to execute the will of the ſoul. In vain does

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the palſical man will to walk; the blind to ſee; the deaf to hear; till the impediments in the bodily organs, are removed. When they, by proper applications, are removed; then the body walks, at the ſoul's deſire; the eyes ſee; the ears hear. Do the medicines work the change in the ſoul? Moſt certainly not.

Matter cannot diveſt the ſoul of its faculties, though it can render it impoſſible for it to exert them, upon the body; which may be ſo diſordered, as not to be able to be directed by it. The ſoul's faculties then are not annihilated, but ſuſpended from action: or to ſpeak more properly, are wrapped up in itſelf. A being may undoubtedly exiſt, without giving appearance of its exiſtence. The ſoul, therefore, may exiſt, without giving ſigns of its exiſtence, or affecting matter ſo as to be conſcious of its own exiſtence: as in ſleep without dreaming, it remains the ſame invariable eſſence; though the indiſpoſition of the bodily organs renders it impoſſible to diſplay thoſe faculties, from whence thought and reflection come.

The

The ſoul is impaſſible, conſequently incapable of change: all the changes that happen to an individual, ariſe from the different affections of the bodily organs. The ſoul of a new born child is the ſame, as that of an old man; and that of a fool, as that of a philoſopher.

The bodily organs, on which the operations of the ſoul depend, greatly vary; by which, the exerciſe of its faculties are proportionably leſſened or improved: but its particular exiſtence, faculties and powers remain the ſame; impaſſible to the laws of matter and motion. The difference between the loweſt and moſt abject, and the higheſt and moſt elevated natural capacity, depends upon the inſtruments by which the ſoul acts and is affected; which ſeem to us to alter its operations. The cauſe is in the material organs, which make repreſentations of its operation; according to their juſt or imperfect mechaniſm. If the bodily organs happen to be perfectly organized and exactly modulated to receive and convey, to the ſenſorium or ſeat of the ſoul, the ideas of objects, with a proper impulſe; then it exerts its

its faculties in a reaſonable manner: the ſenſes receive a juſt or ſufficient degree of impulſe, from the objects; which impulſe the organs convey, in a juſt and ſufficient degree, which excites, in the ſoul, the diſtinct idea of the object.

CHAP.

CHAP. III.

OF THE CAUSES THAT IMPEDE THE SOUL IN THE EXERCISE OF ITS FACULTIES.

WE will now conſider the accidental cauſes, that impede the ſoul in the exerciſe of its faculties. The brighteſt wits, the moſt exalted underſtandings may be reduced to a level with the moſt abject, ſtupid and unintelligent fool; by the mechanical affections of matter and motion. Theſe changes, being poſſible in nature, are often found to happen under divers diſeaſes; when the figure, motion, or texture of the organs are diſconcerted.

We often ſee a man of the brighteſt parts, and moſt enlarged underſtanding, who hath penetrated into the ſecret receſſes of nature, deſpoiled of all his wiſdom, and noble endowments, by the tyranny of a violent fever; a fit of lunacy, &c. &c. Thus we behold him now diveſted of the exerciſe of his faculties: can we ſuppoſe this change made

in the ſoul itſelf? no certainly it remains the ſame, and differs not, from what it was before; recover him from the fever, lunacy, &c. and remove the impediment it hath thrown upon the organs of the ſenſes, and the exerciſe of all the faculties of the ſoul returns; his parts brighten; his underſtanding revives; and in ſhort, he becomes in every reſpect, the ſame amiable perſon as he was, before the fever, lunacy, &c. ſeized him. I verily believe if two men had two bodies, exactly of the ſame model, and converſed with the ſame objects, their ideas, inclinations, capacities, and actions would be the ſame. This will appear more evident, when I come to treat of thoſe diſeaſes, that prevent the regular motion of the ſolids and fluids; eſpecially thoſe that are more particularly concerned in performing ſenſation; and of thoſe applications, that recover them to their regular ſtandard, in conſequence of which theſe ſtrange and unnatural fancies and flights vaniſh; for by removing the cauſe you remove the effect.

There are three ways by which the ſoul may be impeded in the exerciſe of its faculties,

ties, viz. either by the want of objects, of organs, or of a due tenſity in the fibres to carry the impulſe, with juſtice to the ſenſorum. The *firſt* is the caſe of Indians, &c. who have not objects to enlarge their knowledge: the *ſecond* is the caſe of thoſe, who have loſt the uſe of the organs of one, or of all the ſenſes; a perſon, that hath loſt the uſe of the optic nerves, is blind; of the auditory nerves, is deaf, &c: the *third* is the caſe of old men and children, &c.

To underſtand theſe three impediments, we muſt conſider the body in a healthy ſtate, and then we ſhall ſee that every deviation from that ſtandard, incurs a proportionable change, in the exerciſe of the faculties of the ſoul.

Now, in a healthy ſtate, the ſolids are endowed with ſuch an elaſticity, as gives the blood a motion, fit to divide it into a juſt degree of fluidity, and an exact mixture to keep up the ſecretions: then the heart contracts regularly; the arteries beat proportionably; the animal fluids are eaſily moveable, and their motion regular and uniform;

and the nerves are tight, firm and elaſtic; and the organs of the ſenſes are entire and properly dilated and unfolded. Then the body is in its center of perfection, and the point of ballance inclines to neither ſide; and the ſoul expands its faculties to the higheſt elevation it can reach, while confined in matter: then the ſoul feels no pain, no ſadneſs, nor irregular ſtarts of thought. For it is impoſſible, from the neceſſary connection, conſent and agreement of ſoul and body, that there can be pain without the ſoul's perception; becauſe that every perception is what conſtitutes pain: and it is alſo impoſſible that a perſon can fall into ſadneſs from gaity, without a change in the body, which appears heavier (not ſpecifically but relatively) to the ſoul; the fluids move ſlower, which increaſes their attractive power to a degree inconſiſtent with a free circulation, then there appears to the ſoul an additional weight laid upon the body. The thoughts can never ſtart from their natural ſtandard, or regular way of thinking, without inferring a change in the motion of the animal fluids, fibres and ſolids; whether the object, cauſing the irregular turn of thought proceeds

ceeds from the ſoul's reflecting upon a diſagreeable idea; or from a diſagreeable object externally applied to the organs of ſenſe.

In hot, bilious conſtitutions, the ſolids are moſt elaſtic, and conſequently make the ſtrongeſt impreſſion on the contained fluids, which move ſwiftly; and by their heat and friction, are much rarified, attenuated and ſubtilized; whereby they loſe their finer parts. Whence a dryneſs in the habit and great plenty of ſalts; both which are, in proportion, as the ſolids and fluids exceed the ſtandard of health. Then the impulſes from objects are quicker and more imperfect; the thoughts are quick and volatile; the ſoul exerts its faculties with vivacity, though not ſteady; has incoherent ſtarts; cannot dwell long upon the contemplation of ſenſible ideas; as the impulſes upon the ſenſorum are ſtrong and return faſt. The body is ſubject to the ſtone, gout, madneſs, &c. In a bilious conſtitution, the animal æther is plentifully ſecreted; which fortifies the ſoul, gives courage, and a ſprightly livelineſs, and witty turns: diminiſh the ſecretion by bleeding, purging, hunger, &c. then the blood

moves

moves ſlower; and does not attenuate by its attrition, particles, ſufficient to fill and keep properly extended, the ſecretory veſſels; which relax and become palſical: then the courage turns into cowardice, the livelineſs to heavineſs, and the wit to ſtupidity. Take the moſt intrepid ſon of Mars; bleed, purge and allow him ſpare living, and he will ſoon become as great a coward, as before he was courageous. Take the greateſt coward, give him rich food, generous wine, and high cordials; which brace the fibres, increaſe the circulation and ſecretions; and he will ſoon become brave amidſt the moſt imminent dangers. The effects are anſwerable to the cauſes; increaſe the cauſe, and you neceſſarily produce a proportionable increaſe of the effects: ſo that having a certain ſtandard to go by, if we know one, we can judge of the other; which is nothing more than finding a third from two things given.

If the ſolids are too lax, the heart beats ſlowly; the arteries contract proportionally; and the blood moves ſlower, than is needful, to attenuate and prepare it for ſecretion, which is interrupted; conſequently,

ly, the nerves have not a ſufficient ſupply, to enable them to carry an impulſe, ſufficient to give the ſoul a full and ſufficient idea of the object. Whence ariſe faint, languid, melancholy, lethargic, and imperfect ideas; the perſon is ſlow, heavy, dull, and ſtupid. Hence we ſee the abſurdity of ſuppoſing a change in the effects, without firſt making a change in the cauſe, which produced the effects. Some people are born with imperfect nerves; the blind do not ſee, becauſe their optic nerves are incapable of receiving or conveying impulſes; but the ſoul being impriſoned within this material body, has no other inſtrument appointed for it to ſee by, but the optic nerves; which are incapable of performing their office: the incapacity does not reſide in the ſoul, but in the body. A blind man's ſoul is as capable of ſeeing, if placed in a body, whoſe nerves are able to perform their part, as one that has the ſharpeſt ſight. Repair the blind man's optic nerves, and he immediately ſees; and ſo of the other ſenſes.

Again,

Again, if the nerves have not had time, to dilate and unfold themſelves; but remain in ſo relaxed a ſtate, as not to be able to diſplay their actions; then the ideas are faint, languid, and imperfect: becauſe the impulſe is not ſtrong enough to excite a full conception of the object. Sometimes the impulſe is loſt, before it reaches the ſoul; then there is no perception. This is the caſe in childhood and infancy. The one has imperfect ideas, and is unable to retain them long; becauſe the fineſt fibres of the brain are not yet unfolded, which they do by degrees, as they advance in years; which is the reaſon why children are ſcarce able to remember any thing, till they are three or four years old. The ideas, which they receive before that, are ſoon loſt, upon the removal of the object; becauſe of the faint impreſſion they make. If the nerves never form perfectly, then the perſon is more or leſs ſtupid and idiotical, all his life.

If the nerves are impaired by time, as in old age; for old people's nerves are purſed up, ſhrivelled, and contracted; then the

the ſoul has few and faint ideas of the preſent objects, through the impediment of the nerves. In extreme old age, they become ſo purſed up, as ſcarce to give the ſoul any perception. But old men have the free uſe of what they received, before time impaired their nerves: they talk of things paſſed, with the ſame degree of exactneſs they then received them; though, about preſent objects, they ſeem as children and fools; as the external organs of ſenſe are hardly able to receive impreſſions. But the internal fibres of the brain, being more lax than the external, do not contract and dry up ſo ſoon. Therefore they are able to excite perceptions in the thoughts, when the external avenues are entirely blocked up. Whence we diſcover the difference between ſenſation and perception. Senſation, as I have already obſerved, ariſeth from the application of any object, to the ſurface of the body, which is capable of giving an impulſe to the nervous æther. Perception is that faculty of the ſoul, whereby it diſcovers the contact of the object with the animal æther. If, therefore, the nerves, and nervous æther, are quite

dried up in the external ſenſes, yet it may circulate in the brain, ſufficiently ſtrong, to raiſe perception in the ſoul; which may be kept up by the ſoul's colluſion upon the æther. The nerves, indeed, in this caſe, have loſt their impulſe from external objects; and the nervous fibres of the brain become more elaſtic: and were men to live much longer than the common period of life, they would loſe perception as well as ſenſation. And the nerves of the brain would dry up, as well as thoſe of the external ſenſes.

Thoſe objects, that raiſe an eaſy motion in the animal æther, affect the ſoul with pleaſant ideas. Thus, joy gives an impulſe to the animal æther, which makes it move more ſwiftly; the heart, in conſequence, haſtens its contractions; the arteries beat faſter; and the ſecretions, being increaſed, keep up a pleaſing good humour. And if agreeable objects preſent themſelves to the ſenſes, they add to the good humour; which is always more or leſs, as the cauſes are more in number, greater or leſs in quantity; for every ſenſation, or paſſion,

impreſſes

impreſſes a different motion upon the nerves. If joy is in too great an exceſs, then it rarifies and expands the animal æther too much, eſpecially in bilious habits; whence inflammatory fevers, pleuriſies, temporary madneſs.

Again, great ſorrow, fear, or diſappointment, abates the motion of the animal æther; contraction of the heart and arteries; the circulation of the blood; the elaſticity of the veſſels, &c. whence, upon a ſudden fright, or commotion, palpitations and flutterings of the heart, indigeſtion, loſs of appetite, flatuſes and crudity, purging, diſcharge of pale urine, &c. ariſe. And if theſe remain long, they bring on obſtructions and ſchirrous ſwellings, coſtiveneſs, &c.

From whence ariſe the different inclinations and deſires of different individuals? from nothing elſe but the conſtitutional temperaments, more or leſs diverſified, in every individual.

Muſic is agreeable to the ſoul, as it raiſes a uniform and regular motion in the animal æther; and different tunes pleaſe different people, according as they affect their nerves; and if they are too groſs to receive any impulſe from muſic, it is no more agreeable. If the nerves are vitiated, then a ſound, diſagreeable to the nerves in a ſtate of health, will prove agreeable to the nerves in that vitiated ſtate.

If the auditory nerves are too lax, or too contracted, and dried up, the perſon will be deaf, or too quick in hearing. I was told of a lady, whoſe auditory nerves were ſo elaſtic, the effect of a long nervous fever, that ſhe could not bear the ſmalleſt ſound, without great uneaſineſs. If a perſon wrote at a table, in the fartheſt corner of the room from her; yet the motion of the pen affected her, though in bed, with the curtains drawn, as the raſping of iron. How are we rouzed, by ſome kinds of muſic, into martial rage and fury; and, by by others, into jovial mirth and pleaſure: melted by ſome into compaſſion and tears;

while

while others excite painful ſenſations in us, which diſcompoſe the ſpirits, and enfeeble the whole ſyſtem. As there is a ſort of muſic to excite martial courage, ſo there might be a concert of diſcordant ſounds, to inſpire cowardice, conſternation, and deſpair.

Thus we ſee, that the bodily organs may be ſo diſordered, or the ſtimulus, applied to them, ſo great, as to put it out of the ſoul's power to ſuſpend or contract them; and though it is the ſource of all motion, both voluntary and involuntary, yet it may be reduced to an inactive, paſſive ſtate; or forced into involuntary action. Poiſon, received into the ſtomach, throws it into ſo ſtrong and convulſive motions, that the ſoul cannot, by any effort or exertion of its power, prevent it. The fœces and urine, when in large quantity, or very much corrupted, will ſollicit and procure a diſcharge, without the conſent of the ſoul. In an inflammation of the brain, the ſoul is interrupted in the regular exerciſe of its faculties, in ſpite of all its efforts

forts to prevent it. In an inflammatory fever, the heart redoubles its contractions; duſt in the eye cauſes tears; acrid matter, applied to the nerves, cauſes convulſive contractions of the muſcles, in defiance of the ſoul.

Though all voluntary motion proceeds from the immediate influence of the ſoul, yet ſome of the voluntary motions, by the force of cuſtom and habit, come at length to be performed, with little or no attention of the ſoul; though it has full power to begin, or ſtop the motion, when it pleaſes. Thus a man may walk, and not be ſenſible of it; have an object before him, without ſeeing it; and put his hand to a thing, without feeling it; becauſe he is intent upon ſomething elſe; therefore overlooks theſe ſmaller ſenſations; and theſe voluntary motions are, in ſome degree, mechanically performed.

CHAP. IV.

OF THE SPIRITUAL LIFE OF MAN.

HAVING now conſidered man as vegetable; and likewiſe as an animal, compoſed of a body and of a ſoul, or principle of animation, capable of influencing the body, and being influenced by it, according to the mechanical laws of matter; I ſhall now proceed to take a view of the ſpiritual life of man, or, to conſider man as a creature capable of religion; which is the only thing which diſtinguiſhes men from brutes.

Man was, by God, created in innocence and rectitude; and into his noſtrils was breathed the breath of life; whereby he became capable of, and diſpoſed to, receive virtue and religion. This preternatural gift, *this breath* of *life*, gave him a ſuperiority over every beaſt of the field, fowl of the air, and fiſh of the ſea; and in this *alone* conſiſt, the perfection and excellency of man.

This

This divine ſpark, furniſhed him with powers, ſufficient to attain the end deſigned for man, ETERNAL BLISS; which was to commence after ſuch a trial of his obedience, as ſhould ſeem ſufficient to the divine wiſdom. And as part of man has his original from heaven, and part its foundation in the duſt; ſo, the earthly is by nature periſhable; but in order to prevent man's material part, from following its own nature, and turning to corruption; God created the *tree of life*, with ſuch virtue, that, by eating thereof, ſuch a change ſhould be produced in the body, as ſhould qualify it for eternal life. But Adam, by his diſobedience, loſt the benefit of the tree of life: and the conſequence God declared unto him, ſaying, DUST THOU ART (meaning his bodily part) AND TO DUST SHALT THOU RETURN.

The communion, influence, or operation of the Holy Spirit, whereby man was intitled to the dominion over the reſt of the creatures; and is that principle, which diſtinguiſhes a man from a beaſt, was alſo withdrawn at the fall. Accordingly, though all

nature

nature was willingly obedient to the will of man before the fall; yet immediately after the fall, when man had almoſt loſt the principle, that diſtinguiſhed him from the reſt of the creation; and entitled him to the obedience of all other animals; they became diſobedient, fierce and cruel. If the *image of God, the divine influence, the operation of the Holy Ghoſt, or the breath of life*, had been wholly withdrawn, then, man would have retained nothing to diſtinguiſh him from other animals: but it was not completely loſt by the fall; mankind retained ſome remainder of it, ſome veſtiges of it, as well as of the dominion which was originally founded upon it: otherwiſe man would not have long continued king of the creation.

Man had not, after the fall, the divine principle, cloſely embracing his nature within and without; and always abiding in him as a divine nature, making up the perfect man, i. e. making man perfect, with regard to that ſupernatural and ſpiritual perfection, originally deſigned for him; and for which this union of the divine ſpirit with the ſoul

and body, as it were a third principle, was neceſſarily required. Yet God ſtill continued ſome inferior communications of his holy ſpirit with man; though now only as a principle EXTRINSICAL to his nature. Thus it ſtill continued, as the light of the rational faculty. So the communications of the ſpirit are owing to thoſe ſuggeſtions of prudent and reaſonable thoughts, which are neceſſary, not only for the good management of the affairs of this life, but alſo for the concernments of religion and a future ſtate.

By the influences of the ſpirit, the Jews were enabled, if not wanting to themſelves, to perform that duty, which their law required of them, as a pedagogue to bring them to Chriſt. By them alſo, the Gentiles, who had not the law of Moſes, were enabled to be a law unto themſelves; thereby they had the work of the law written in their hearts; and did the things contained in the law. The teachableneſs, which the Goſpel requires, called the *drawing of the Father*,

Father, is the effects of the operation of the Holy Spirit. Yet, theſe inferior communications of the ſpirit, theſe remainders and footſteps of the Divine Image, as a principle only EXTRINSICAL to our nature, are not, of themſelves, ſufficient to enable us to perform the duties, required by God, as conditions to entitle us to eternal bliſs in the kingdom of heaven; which is the gift of God, and no way due to our nature, or to our beſt performances.

The inhabitation of the ſpirit, as an internal principle united to our nature, and not an inferior communication of it, as a principle only extrinſical to our nature, was neceſſary to our firſt parents themſelves, in a ſtate of innocency, to exalt them to that bliſs, for which God deſigned them. Therefore it muſt be much more ſo to their fallen poſterity. But, by the death and paſſion of our Saviour Chriſt, the divine image or ſpirit of God, as an inherent principle, is reſtored to us; and thereby we recover that happy ſtate, which Adam loſt by his fall. Chriſt reſcued us by ſatisfying the penalty of Adam's tranſgreſſion; and ſtating him-

ſelf the Mediator of a New Covenant, betwixt God and man; by the obſervation of which, we may again recover that happineſs, originally deſigned for us.

In our chriſtian baptiſm of the ſpirit, we receive the ſpirit of adoption, and are reſtored to that divine image, which Adam loſt by his fall. This is evident from the expreſſions uſed concerning it in Scripture. It is called *the renewing of the Holy Ghoſt*; *the being renewed by the ſpirit of our mind, i. e. by the ſpirit* in our mind, as St. Chryſoſtom explains it: the NEW MAN, *which is renewed in knowledge, after the image of him that created him.* By all which is properly ſignified, the reſtoring a thing to its former ſtate, which it once had; but loſt; and not making a thing new, which had never been before. None have that quickening ſpirit (now reſtored by Chriſt, who purchaſed it again, and beſtowed it on his church, as a triumphal gift upon his aſcenſion) 'till he receives it in the chriſtian baptiſm of the ſpirit; which is therefore called regeneration; as being that, by which this

this new life is firſt infuſed into us. And the author of the epiſtle to the Hebrews obſerves in general, concerning all thoſe Patritriarchs and other holy perſons, who, by their faith, pleaſed God, before the coming of our Saviour; that they could not WITHOUT US be made perfect; the ſpirit, as has been obſerved, is neceſſary to conſtitute the perfect man; which the apoſtle calls *whole*, conſiſting of ſpirit as well as ſoul and body.

This ſpirit was not given by the works of the law (which could not make the comers thereunto perfect, being only the bringing in of a better hope, by which we draw near unto God) but by the hearing of faith, i. e. by the Goſpel. Accordingly the Evangeliſt tells us, that it was not given till Jeſus was glorified; this being a particular part of his teſtament, it could not be of force, till the death of the teſtator. And thence our Saviour himſelf diſtinguiſheth betwixt the preſence of the ſpirit with his diſciples, as an external aſſiſtant, while himſelf was alive with them, and that inhabitation thereof, as a God in a temple, which they were only

only afterwards to receive upon his aſcenſion. *For he dwelleth with you,* ſays he, and *ſhall be in you.*

From theſe principles, many inferences, of the greateſt importance, might be drawn; we ſhall here only beg the readers patience to hear two or three.

It is evident, that no moral duties whatſoever, that can be performed out of the communion of the church, however the aſſiſtance of the holy ſpirit, as an external principle, be neceſſary to produce them, can ever give an immediate title to the eternal bliſs in the kingdom of heaven. For even theſe inferior communications of the ſpirit, were continued only in conſequence of our Saviour's undertaking to atone for the ſins of man; and was deſigned to prepare and enable us, to receive the covenant of grace. And whoſoever goes on in ſin and wickedneſs, and refuſes the terms of the Goſpel, does, ipſo facto, deprive himſelf of the inferior communications of the holy ſpirit, and forces God to withdraw it from him; for he declares he will

will not always contend with us. And man then becomes in a level with the brutes, and inherits no principle, that poſſibly can diſtinguiſh him from them; but only this, that upon his repentance, and embracing the Inſtitutions of God Almighty, he may find mercy; and his ſincere repentance, and his after willing obedience may be rewarded with eternal bliſs, in the kingdom of heaven; which never was deſigned for other animals; and thereby can, by no poſſible means, be attained by them. And none, without performing theſe conditions, can have any more title to the kingdom of bliſs, than a horſe or other animal.

The exceeding great and precious promiſes of the New Covenant, which Chriſt hath purchaſed for his church, can never be obtained by any other means, but thoſe which he hath preſcribed in the Goſpel, for conveying of it; and they are none other than the chriſtian ſacraments, by which this New Covenant itſelf is tranſacted and maintained; and by which we are made and continued members of the church. Hence our bleſſed

Saviour

Saviour aſſures us, that except we be born again of water and of the ſpirit, we cannot enter into the kidgdom of heaven: and unleſs we eat the fleſh of the ſon of man, and drink his blood, in the euchariſt, we can have no life in us; and that it is by our eating his fleſh and drinking his blood, that he dwelleth in us, by the inhabitation of his ſpirit, and we in him, as members of his body, the church; and that thereby we have eternal life; and he will raiſe us, raiſe our bodies, at the laſt day, by this quickening ſpirit, which dwelleth in us; and ſhall quicken our mortal bodies. For our ſouls are in themſelves, immortal.

From whence it appears, that as the baptiſm of water, reſtores the perſon to that primitive purity and ſimplicity, in which Adam was created, and placed in Paradiſe; and as the baptiſm of the ſpirit or confirmation, infuſes into him the breath of life; and thereby the divine image which was loſt in Adam, is reimplanted in him. So the conſtant participation in the ſacrifice of the euchariſt is as neceſſary for our continuance

and

and growth in this divine life of the ſpirit; as our bodily food is for the ſupport of our natural life.

If therefore we cannot have the ſpirit, nor any other benefits of the chriſtian covenant, without an external participation in theſe ſacraments, by which the covenant is tranſacted and maintained, and which God has appointed as the only ordinary means of conveying them to us. For we cannot be ſure of, nay, expect God's ſupplying the want of theſe ordinary means, which himſelf hath appointed, by extraordinary and uncovenanted favours, but upon a perfect impoſſibility, either phyſical or legal, of obtaining them.

And if theſe ſacraments derive their whole efficacy, not from their own nature, but from their conſecration.

And if this power of conſecrating them muſt be derived from God, who only has the diſpoſal of theſe benefits, conferred by them; ſo that none can validly conſecreate

them without an authority, derived from him for that effect.

And if none can lay any juſt claim to that authority, but they who received it from thoſe, who had power to give it them, in a continued ſucceſſion from the Apoſtles, who at firſt received it from Chriſt.

This will neceſſarily oblige us, as we value our eternal ſalvation, to a ſtrict dependence upon, and ſubmiſſion to them, who thus have alone this power of conſecrating the ſacraments.

For, without a commiſſion from God, 'tis as impoſſible for a perſon validly to adminiſter the ſacraments, to the benefit of the receiver, which is a New Creation, as to form a man out of duſt, with all the qualifications and properties, with which he is endued. But none can act, as commiſſioned from God, who do not obſerve the conditions required of them; for the divine influence, which is the eſſence of a ſacrament, can never be ſuppoſed to accompany theſe inſtitutions,

when

when performed contrary to the revealed will of God: for it is, in obedience to his divine precepts, that he promiſes his bleſſings. Hence we ſee the invalidity of lay and ſchiſmatical adminiſtrations; the one had never a commiſſion; the other has forfeited it, by giving up the depoſitum committed to his truſt: he has broke his covenant with God, and entered into covenant with the devil.

Therefore he muſt have a very imperfect knowledge of the nature of the chriſtian prieſthood, and of the ſacraments; who thinks, that a ſacrament can be, in whole or in part validly performed by any ſuch. One would believe that a perſon with half an eye might ſee, how deſtructive ſuch an opinion is, both to the inſtitution of the prieſthood, and alſo to chriſtianity. But timidity and human prudence ſuggeſted theſe opinions, and perhaps, in time, will offer us, what they think reaſons, or to give up our ſenſes with our religion. And forſooth theſe very men would have it thought that they ſuffer for truth and righteouſneſs ſake, yet can diſ-

penſe with both, when human prudence calls for it.

I ſhould now, in the laſt place, proceed to conſider the ſymptoms, cauſes and manner of cure, in nervous diſeaſes; but I am well aware ſome objections will be made to the preceeding doctrine, which I am here inclined to anticipate.

If our five ſenſes, which are common to us with brutes, are the only ſource and inlets of thoſe ideas, which are the intire ground work, and firſt foundation, upon which we raiſe the whole ſuperſtructure of all our knowledge, both human and divine; and if that maxim of logicians is to be taken for a ſure and fundamental truth, "nihil eſt "in intellectu quod non fuit prius inſenſu," then all diſcoveries we can make in things, temporal or ſpiritual, together with the moſt refined and abſtracted notions of them in the ſoul of man, take their riſe originally from ſenſation; and if we cannot think or be conſcious of thinking, till we have ſome idea of an object to think upon; and if without

out our ſenſes we can have no idea of any thing without us: then what will become of all our knowledge of the things of another world? of all revealed religion; and the truths of morality; and the myſteries of chriſtianity? I anſwer, that ſeeing we can have no idea, but from ſenſible, material objects; therefore we can have no idea of God, Angels, or any immaterial ſubſtance, or indeed any thing beyond the Sun and Stars; yet I truſt in God, our religion is very ſafe.

At our birth the imagination is entirely a *tabula raſa* or perfect *blank*, without any materials, either for a ſimple view or any other operation of the intellect. We are not furniſhed with any *innate* ideas of things material or immaterial; nor are we endued with a faculty or diſpoſition, of forming purely intellectual ideas or conceptions; independent of all ſenſation: much leſs has the ſoul of man a power of raiſing up to itſelf ideas out of nothing, which is a kind of creation; or attaining any firſt principle; excluſive of all *illation* or conſequential deduction from ideas of material objects; without which the ſoul of man, during its union with

with the body, could not attain even to the knowledge of its own *exiſtence*: Deprive the body of ſeeing, hearing, taſting, and ſmelling; and the ſoul would not be able to know any thing but what the hand or body *felt*: and if he was deprived of that ſenſe too, the ſoul would be utterly void of all ideas, and conſequently all knowledge.

As therefore we have no idea of God, we are obliged to come to the knowledge of his very exiſtence, not from any idea we have of him, or from any direct intuition of the intellect; but from the obſervation and reaſoning of the mind, upon the ideas of ſenſation; that is from our reaſoning upon the works of the viſible creation: and for want of a ſimple and direct idea of him, we frame to ourſelves the moſt excellent conception, of him we can, by putting together into one, the greateſt perfections, we obſerve in the creatures, and particularly in our own reaſonable nature, to ſtand for his perfections. Not moſt groſly arguing and inferring that God is ſuch an one as ourſelves, only infinitely enlarged and improved, in all our natural powers and faculties; but concluding, that

that our greateſt excellencies are the beſt, apteſt, and moſt correſpondent repreſentations of his incomprehenſible perfections; which infinitely tranſcend the moſt exalted of what are to be found in any created beings; and are far above out of the reach of all human imagination.

The riſe and whole extent of our knowledge, of immaterial objects, are accounted for, from the ideas of ſenſible objects; from the neceſſary conſequences we draw from their exiſtence, to the exiſtence of things not ſenſible; and from that manner of conceiving theſe, which we afterwards naturally fall into, by the help and mediation of ſuch things as are within the compaſs of our preſent ſphere. Thus we conceive the knowledge of a ſpirit, by the mediation of our thinking, and the various modes of it, exerciſed on ideas of ſenſation. If we had any innate ideas of ſpiritual things, they would be as direct and immediate as the ideas of ſenſible objects are: they would be as true and proper repreſentations of them, as they are in themſelves;

ſelves; and no way analogical, as they now are. We have not even the leaſt direct idea, or perception, of the purely ſpiritual part of us; nor do we diſcern any more of its real ſubſtance, than we do of an angel. We are ſo far from an exact view, and intuitive knowledge, that we are forced to argue, and infer its exiſtence, from our obſervation only of ſuch operations, as we conclude could not proceed from mere matter.

And, becauſe we have no direct idea of it, we expreſs its nature, as we do that of a ſpirit in general, by the word *immaterial*. And as we cannot form one thought of our ſoul, otherwiſe than as it is in conjunction with the body; ſo neither can we conceive any of its operations, but as performed together with bodily organs: and therefore it is, that we are under the neceſſity of expreſſing the *modus* of them, in words borrowed from ſenſation and bodily actions. The mind, or ſpiritual part of us, cannot, by any direct or reflex act, look upon or into itſelf, any more than it can diſcern

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the ſoul, in its ſtate of ſeparation from the body.

And ſo it is, with reſpect to God and his attributes; we can have no direct view, or intuition, by the eye, of body or ſoul, (for indeed they are both one) of any thing in the divine nature: therefore there is no way of beholding him, but in the *mirrour* of the viſible creation; and particularly in ourſelves. So we behold his wiſdom, in our thinking and reaſoning; his power, in our worldly dominion and power; his goodneſs, in the rectitude of our own moſt commendable affections. Not by adding *infinity* to each of theſe, as ſome have groſly miſtaken, ſo as to ſtretch our imagination, as far as we can, to infinite thinking, infinite power, infinite rectitude; but by adding infinity to thoſe incomprehenſible perfects in the divine nature, of which we have not the leaſt idea, the leaſt direct glimpſe or knowledge. The true nature and manner of the preſent knowledge we have of things in another world is, by the apoſtle, very aptly deſcribed, by ſeeing

through a glaſs darkly; and our future knowledge of them, by ſeeing face to face. A glaſs, or mirrour, exhibits to us nothing of the reality and ſubſtance of the thing repreſented in it.

The ſimilitude formed by the reflection of the object, hath no more of the true eſſence and properties of the thing itſelf, which it exhibits, than a mere ſhadow; and is nothing more than the appearance, which periſheth with the removal of the object. Thus it is with thoſe conceptions, which ſtand in our minds to repreſent God, and ſpiritual things.

Though the things they are ſubſtituted for, are of a quite different kind; and though thoſe ſubſtitutes are no more, in reſpect of them, than a fleeting, tranſient appearance only in the glaſs, is to the man himſelf, whom we ſee in it; yet there may be ſuch a likeneſs, proportion and *analogy*, between them, as may render our natural and familiar conceptions of worldly things apt and JUST repreſentations of things *ſupernatural*,

pernatural, and particularly of the *divine nature*. In ſo much, that the knowledge we have of them, by that *analogy*, though imperfect, ſhall be, however, *true* and *real*; and all our juſt thoughts and reaſonings upon them ſhall be ſolid and ſubſtantial; as long as they are kept within the due compaſs of theſe ſimilitudes and repreſentations of them. For then it is that men run into ſoliciſm and abſurdity, into error and confuſion, concerning God and ſpiritual things; when they, not contented with this imperfect degree of knowledge, by repreſentation only, and analogy, will argue, from things merely natural, to the real intrinſic nature of theſe things, which now we can know no other way, but by that ſimilitude, correſpondence, or proportion, they bear to our natural ideas and conceptions.

So that in reſpect of all things relating to the *real*, *true* nature of immaterial beings, as they are in themſelves, we are not as a man, who hath a very dim ſight, or who can diſcern *direct*, *though faint*, glim-

merings of light, and hath ſome *immediate*, though no more than *confuſed* and imperfect views of viſible objects; but we are as a man born *blind*, in reſpect of light and colours.

As we can have no ideas of immaterial beings, from our ſenſes; neither have we any ideas of them that are purely *intellectual*, and entirely independent of ideas of ſenſation. We have not the leaſt ſpark of light, or ſmalleſt glimpſe, whereby to diſcern their real nature or eſſence, or any part of it. So that, thus far, it is not an indiſtinct or obſcure perception, but no perception at all.

Therefore, all our knowledge of revealed truths and myſteries, is by *ſemblance* only, and *analogy*. Yet, ſince God has formed us to his own image and likeneſs, we have a firm reliance, truſt, and dependance upon his wiſdom and veracity, for ſuch a juſt reſemblance, proportion, and correſpondency between the ſcripture types, which are natural, and the ſupernatural anti-types, as

renders

renders that kind of knowledge ſolid and real; the faith built upon it certain and firm; and our hope well grounded and ſure.

Then only we are in danger of running into error and deluſion, and may be fatally deceived, when we turn it into mere *metaphor* and *alluſion* only; or when we ſtrain that analogy, by which we conceive things ſpiritual, to an undue and literal compariſon with things natural and human; and in ſuch inſtances as never was intended by the wiſdom of God. Or, laſtly, when we begin to imagine that we have, in any degree, a direct and immediate perception of things ſupernatural.

The mind of man, while it keeps within its own proper *ſphere*, acts with freedom and ſecurity; but when it ſtrives to exert itſelf beyond its native powers and faculties, then it ſinks into weakneſs and infirmity, and is ever liable to endleſs miſtake and error. It hath no direct perception, or *immediate* conſciouſneſs, beyond things

ſenſible

ſenſible and human. So that in all its nobleſt efforts, and moſt lofty flights, it muſt ever have a ſteady eye to the earth, from whence it took its riſe; and always conſider, that it mounts upwards with *borrowed* wings. For when once it preſumes upon their being of its own natural growth, and attempts a direct flight to the heavenly regions; then it falls headlong to the ground: where it lies grovelling in ſuperſtition and infidelity.

I ſhall now proceed to the third general head of my diſcourſe, viz. to conſider the ſymptoms and cauſes of nervous diſeaſes.

SECT.

SECT. III.

CHAP. I.

OF THE SYMPTOMS AND CAUSES OF NERVOUS DISEASES.

IN almoſt every diſeaſe, the nerves ſuffer more or leſs; and there are very few diſorders, which may not in a large ſenſe be called nervous. But I ſhall here confine myſelf to thoſe complaints, which proceed from a weak or unnatural conſtruction of the nerves: the ſymptoms that ariſe from theſe cauſes are ſo many, various and irregular, that it is extremely hard, either rightly to deſcribe, or fully enumerate them. They mimick almoſt every diſeaſe; and indeed there are few chronic diſeaſes with which they are not more or leſs blended and intermixed. I have, for method's ſake, divided nervous diſeaſes into different ſtages, but you muſt not expect accuracy or certainty in this; becauſe ſome of the ſymptoms, I

have mentioned in the ſecond ſtage, may, in ſome patients, be found in the firſt, and *vice verſa*. In treating therefore of the ſymptoms and cauſes of nervous diſeaſes, I ſhall obſerve that method nature moſt commonly follows, and advance ſtep by ſtep along with the diſeaſe; taking hold of one end of the chain, ſhall endeavour to fathom it to the other; for all nervous diſeaſes, from *yawning*, *ſtretching*, &c. to a mortal fit of an apoplexy, or raging madneſs, are one continued diſorder, or the ſeveral ſteps of it.

A child may be born with weak nerves, and from original conſtitution liable to nervous diſeaſes. Others, who have been born with ſtrong, healthy and ſound conſtitutions, may afterwards fall into them, from any accident, as a fall or bruiſe, wound, fright, bad and low diet, hard labour, injuries of the weather, intemperance, ſenſual pleaſures; acute diſeaſes, immoderate evacuations, &c. Thoſe who have weak, feeble or relaxed nerves, have generally a ſmall, weak, languid, and ſometimes intermittent pulſe; the ſtrokes are ſeldom clean and free; their

their fleſh is ſoft and yielding, looſe and flabby; their complexion is white, fair, blanched or aſh coloured. Thoſe, who are ſubject to great evacuations, or have laboured under preternatural diſcharges from any acute diſeaſe; who run into purging or coſtiveneſs alternately, into floods of pale urine; or into profuſe ſweats upon little exerciſe; who have made too liberal a uſe of mercurials, have fallen into immoderate hæmorrhages; or have laboured long under a diarrhæa; women, who have purified oftener, or in greater quantity, than is natural; originally have, or generally ſoon have weak nerves. They are commonly of a cold conſtitution; apt to fall into chilling and coolneſs in the extremities; or frequently feel like a trickling of cold water down the back; and often fall into ſhiverings. All theſe ſigns proceed from too ſlow circulation and perſpiration; which indicate a weakneſs and laxity in the veſſels. For perfect health, free ſpirits, eaſe and chearfulneſs, conſiſt in the eaſy, pleaſant and uniform performance of the animal functions, viz. a full circulation, free perſpiration and

regular ſecretions and excretions; when theſe are interrupted and forced, then nervous ſymptoms ſoon follow.

There is a tranſient ſpecies of vapours, which ſometimes ſeizes temperate people, otherwiſe ſtrong and healthy, of ſound juices, and firm ſolids; ſuch as lowneſs, reſtleſsneſs, heavineſs, anxiety, averſion to exerciſe, head-achs, dimneſs of ſight; theſe proceed from catching cold, which obſtructs perſpiration; from indigeſtion; or from a foul ſtomach. Theſe ſymptoms vaniſh, in a little time, of themſelves, or may be removed by a *cordial draught*, *gentle emetic*, *ſtomach purge*, *light diet* or *abſtinence*.

Some people are endowed with ſuch an uncommon delicacy of ſenſation, that, though uſually in good health, they are ſubject to tremors, palpitations, faintings, fits, &c. from fear, grief, ſurprize, or other paſſion; or from any other cauſe that irritates or unuſually affects their nerves. They are alſo more or leſs ſubject to indigeſtion, flatulencies, flying pains, irregular and partial fits of heat

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and cold, frequent ſighing, inquietude, pale urine, irregular ſpirits, &c.

Others there are, who are ſubject to ſome nervous ſymptom from the very contrary cauſe, viz. an obtuſe or leſs ſenſible feeling of the nerves in general; which occaſions indigeſtion, flatulence, either a want of, or too great an appetite, coſtiveneſs, looſeneſs, fluſhing, giddineſs, oppreſſion about the *præcordia*, low ſpirits, diſturbed ſleep, &c.

From theſe two cauſes, moſt nervous diſeaſes generally ariſe. The firſt may be either natural or produced. All children, compared with men, have their nerves very ſenſible, whence they are ſo ſubject to convulſive fits from teething, worms, acids in the *primæviæ*, and before the eruption of the ſmall pox, &c. Some adults have ſo delicate and ſenſible nerves, that a vomit, ſmart purge, bliſter, ſudden fright, &c. will throw them into convulſion fits. Women, whoſe nerves are generally more delicate and ſenſible than thoſe of men, are moſt ſubject to nervous complaints. The variety of the quickneſs

of the pulſe, in a healthy ſtate, is owing to the ſenſibility of the nerves in general: and as the nerves in different parts of the body are endowed with various kinds of feeling, ſo they are more or leſs liable to be affected with the ſame diſeaſe. Therefore certain diſeaſes affect ſome parts of the body more than others. In ſome epidemical diſeaſes, the eyes, fauces or breaſt, in others, the inteſtines are moſt liable to be affected; owing to the weakneſs and great irritation of theſe parts, by the application of acrid and morbid matter.

Beſides a too great ſenſibility of the nervous ſyſtem in general, there is ſometimes an unnatural and depraved feeling in various parts of the body; which ſubjects perſons to extraordinary affections. For example, muſk, amber-greaſe, pale roſes, tanſy, cheeſe, a cat, &c. will cauſe ſome people to faint, vomit, purge, &c. The diſpoſition of the nerves of the ſtomach is the reaſon, that ſome kinds of food agree with ſome people, and diſagree with others; nay, even with the ſame perſon at different times.

Some

Some medicines have violent effects upon ſome, while they have little or none upon others. Hence we ſee that a delicate and unnatural ſtate of the nerves, either in the conſtitution, or acquired by intemperance, &c. muſt diſpoſe people to nervous diſeaſes.

I come now more particularly to enquire into the ſymptoms and cauſes of nervous diſeaſes.

The ſpleen and vapours are nearly ſynonymous terms; the ſymptoms and cauſes are the ſame: only the vapours ſometimes bring on fits, and as theſe fits are moſt frequently obſerved in women, we call the ſame diſeaſe vapours in women, and ſpleen in men. The ſpleen and vapours, improved upon the conſtitution, arrive at another ſtage; and is then called the *hip*, or hypocondriacal melancholy: and is for the moſt part attended with a ſcurvy. So that the ſame cauſes, which produce the ſpleen and vapours, if allowed to continue long, will produce the hip, which, if ſuffered to continue

tinue, advances ſtill further on, and makes a tranſition to madneſs. If the conſtitution is bilious, then the madneſs is raging and furious, called *mania*, *lunacy* or *frenzy*; if the habit is cold and phlegmatic, then the madneſs is a ſettled, fixed, moaping *melancholy*.

All nervous diſeaſes ariſe from RELAXATION, or OBSTRUCTION: and as the one cannot continue long without producing the other, ſo they mutually exaſperate each other; and, in a habit naturally diſpoſed to nervous complaints, ſoon produce very troubleſome ſymptoms, which, from the ſlighteſt, to the moſt ſevere, have their exacerbations and remiſſions. Many accidents in living contribute to make them irregular in their returns, and in the ſlighter caſes they are ſeldom taken notice of.

Acrid, noxious matter, bred in the blood, from either of the above cauſes, will produce nervous ſymptoms, as violent periodical head-achs, irregular pulſe, partial ſweats, itching heats, fluſhing and irruptions ſud-

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denly disappearing, in different parts of the body, *nausea*, wandering pains, convulsion of particular muscles, tightness at the breast, pain in the bowels, &c. This morbid matter, which occasions these and many other symptoms of the nervous kind, may arise from very different causes, as too much or improper food. For the end and design of eating and drinking, is to supply the waste of our bodies, and to keep up the due ballance between the solids and fluids. The necessary friction and collition from the motion of our juices, in order to break and subtilize their parts, and to fit them for the animal functions, make a continual waste; to supply which, it is absolutely necessary to take a proper proportion of nourishment. By the rules of animal œconomy, there is a necessity of keeping up the ballance between the elasticity of the solids, and the resistance of the fluids, to preserve the individual in health. And when any of these two rules are long or greatly transgressed, by either taking more than is necessary to supply the waste, or by taking that, which from its natural quality, destroys the ballance; then the

the individual ſuffers in proportion as the ſolids and fluids are removed from the ſtandard of health. Crudities and indigeſtion lay the foundation for the greater number of diſeaſes, that torture and afflict human life. If a perſon, whoſe ſolids are tenſe and firm, wallows in luxury and riot, for any conſiderable time; he fills his blood with oily, ſulphureous, and inflamable particles; which, being driven about with too great force and velocity, are thereby forced into the ſmall capillary veſſels, deſigned to receive the lymp, or thinner part. Thus inflamatory and acute diſeaſes are formed, ſuch as fevers, gout, eriſipelas, rheumatiſm, &c. If theſe ſmall lymphatics, by the force of the circulation, or groſſneſs of the fluid, are torn and broken, then impoſthumes, gangrenes, mortifications, &c. follow. But if the perſon purſues this courſe a little more ſlowly, and joins lazineſs or want of exerciſe to it, ſo that the acrimony and ſtock of bad humours increaſe, as the ſolids are relaxed, and weakened; then the ſlower, colder, the nervous and more chronical diſeaſes are produced.

Alſo

Alſo a ſcorbutic or ſcrophulous habit, fevers imperfectly cured, and cutaneous diſorders, when the morbid matter, inſtead of being thrown out upon the ſkin, is reabſorbed and depoſited on the internal parts: produce nervous ſymptoms.

But above all, a wandering and imperfect gout, is oftenest the cauſe of nervous diſeaſes; it will occaſion lowneſs of ſpirits, loſs of appetite, *nauſea*, ſickneſs at the ſtomach, vomiting, palpitations of the heart, irregular pulſe, difficult breathing, ſwimming and ſhooting pains in the head, delirium, mania, wandering pains now in one place then in another, flatulencies, cramps, convulſions, &c. Theſe ſymptoms may proceed from an irregular gout; the matter of which, inſtead of going to the extremities, wanders through the body. When this morbid matter is carried ſmoothly on, without forming obſtructions, or too violently irritating the nerves; then it gives little trouble: when it remains fixed in the extremities, or muſcular parts, it occaſions aching, goutiſh and rheumatic pains: when it ſettles on the viſ-

cera or more ſenſible parts, it ſtimulates the nerves, and produces many nervous ſymptoms, which are greater or leſs, according to the ſenſibility of the nerves. This happens to people of weak and delicate habits, and ſenſible nerves; eſpecially to women, who have ſeldom a true gout, but a wandering gouty humour; if the conſtitution is a little ſtronger, then the patient is afflicted with cold rheumatic pains, and ſometimes with a regular fit of the gout: if the vital organs and the vaſcular ſyſtem are ſound, then the arthritic matter is thrown upon the extremities; by which means the body is cleared of it. In the cure of the gout, rheumatiſm and *ſciatica*, nothing is better than iſſues, bliſters, cataplaſms, pedeluvium, antimonial, camphorated and cordial diaphoretics, with a little venice treacle, &c. the conſtant uſe of bitters, ſteel and the bark.

An obſtruction of the *menſes* or hœmorrhoids, alſo ſetons, iſſues, old ſores, too ſuddenly dried up, or the ſweating of the feet obſtructed by cold, will occaſion nervous ſymptoms. We ſee, at the time of life, when

when the courſes ceaſe, and for ſome months after conception, the change of the circulation, the diſtenſion and irritation of the womb, occaſion *nauſea*, vomiting, faintings, depraved appetite, convulſive fits, aſthma, heavineſs, and flying pains, flatulencies, head-ach, &c. As theſe ſymptoms ariſe not from the quality, but from the quantity of blood; therefore the *plethora* is to be removed moſt effectually by bleeding, or by an emetic or emmenagogue, as indications direct.

We will now conſider the particular ſymptoms with their cauſes; in the order they generally obſerve.

1*ſt*. The firſt ſymptoms are a dull, heavy uneaſineſs, debility, faintineſs, a ſenſe of great emptineſs about the ſtomach, a yawning, gaping, ſtretching out the arms, twitching of the nerves, ſneezing, ſometimes drowſineſs and lethargy, heaving up the breaſt: as theſe ſymptoms have little pain, but a kind of wearineſs, they are neglected. The complexion becomes wane, pale, and not ſo lively, the eyes appear dull

and faded, the appetite is faint and unequal, returning by fits, and if meat is not immediately given, the patient is like to faint away, and the appetite goes off; at other times the hypochondres are ſo inflated with wind, that the patient cannot eat: he complains of heartburns, belchings, and bilious vomiting, pain in the pit of the ſtomach, attended ſometimes with ſhortneſs of breath, or ſymptomatic aſthma, tickling cough, and at other times with an inflation or viſible ſwelling; and the patient perceives unſual ſmells. After theſe ſymptoms have continued ſome time, they produce lowneſs of ſpirits, faintineſs, anxiety, watching and reſtleſneſs; ſometimes great timidity, a dizzineſs of the head, inveterate pains in particular parts, about the ſize of a crown, ſharp and acute pains in the temples, and other parts of the head; ſometimes there is a tingling noiſe or hiſſing ſound, a thumping, or beating in the inſide of the head; the temporal arteries, at times, beat ſo ſtrongly, in the night particularly, as to occaſion ſo conſiderable rubbing or friction againſt the bed-cloaths, as to be heared by a byſtander. The patient perceives

perceives a faintineſs to ſeize him, which is ſucceeded with motes, clouds, and miſts, floating backward and forward, in the atmoſphere before his eyes; a coldneſs and chillneſs ſeize the extremities; a burning in hands and feet; fluſhing, eſpecially after meat; cold damp ſweats, fainting, and ſickneſs, which is removed by a lax ſtool. The patient is very irregular in going to ſtool, ſometimes he is too coſtive, at other times lax; the ſtools are of various colours, ſometimes of a mucous, jelly-like ſubſtance, at other times black, dark brown, green and yellow; ſudden fluſhes of heat, eſpecially in the night over all the body; ſhiverings, a ſenſe of cold, in certain parts, eſpecially down the back, as if water was poured on the body; at other times, an unuſual glow of heat; troubleſome pains between the ſhoulders; pains attended with hot ſenſations; cramps, and convulſive motions of the muſcles, or a few of their fibres; ſudden ſtartings of the tendons of the legs and arms; large and frequent diſcharges of pale and limped urine. Some have all theſe ſymptoms, others have but ſome of them; but

a pty-

a ptyaliſm, or diſcharge of phlegm from the glands of the throat, generally attends all the ſymptoms. In the firſt period you may obſerve one good day, and another bad; and alſo monthly periods: but theſe periods or criſis are very uncertain and irregular, as I obſerved before. The weather too, has a ſurpriſing effect upon nervous people. When theſe ſymptoms have continued ſome time, they ſo relax the fibres of the ſolids, that the digeſtion is very imperfectly and ſlowly performed, conſequently wind, crudities, &c. are bred in the *primæviæ*, which produce many more and diſmal ſymptoms, as:

2*dly*, Frequent rifts, belchings, hiccups, ſtrange grumbling, croaking, and murmuring in the bowels; troubleſome heartburns, ſour and very acrid belchings, and ſqueamiſhneſs; vomitings of watery ſtuff, tough phlegm, corrupted bile, a viſible ſwelling and inflation of the ſtomach, eſpecially after eating; weakneſs and trembling of the limbs; wandering pains, ſuddenly ſtarting from one place to another; wandering pains in the ſides, back, knees, ancles, arms, wriſts,

wriſts, not unlike rheumatic pains; cold ſhiverings running down the back bone, often after making water, like the cold fits of an ague; ſometimes there is a heat in one part of the body, then in another; the head is generally hot, even while the reſt of the body is cold and chilly; the hypochondres, but moſt frequently the right one is ſwelled. Now the patient has vertigos, long faintings, the ſlighteſt motion raiſes pains in the head, which often return periodically; alſo moiſt, cold, clammy ſweat, greateſt commonly about the temples and forehead, obſtinate watchings, diſturbed ſleep, frightful dreams, and ſometimes a drowſineſs and too great an inclination to ſleep, the night mare; often ſtarting when awake, terribly affrighted with horrors: any ſudden ſurpriſe greatly affects and often throws the patient into fits and faintings, tremors or palpitation of the heart; the pulſe very variable and irregular; a ſenſe of ſuffocation, frequent ſighings, convulſive twitchings of the muſcles, tendons and nerves of the back, loins, arms, hands, and a general convulſion affecting, at once, the ſtomach, bowels, throat, legs, arms, and indeed almoſt the whole body, in

which

which the patient ſtruggles as in a violent epileptic fit. The patient ſometimes falls into a *catalipſis* and *tetanus*, and ſinks gradually into a nervous atrophy: has generally a quick apprehenſion, forgetful, unſettled and conſtant to nothing but inconſtancy, jealous; has wandering and delirous imaginations, ridiculous fancies, groundleſs and impertinent fears, often complaining of his ſufferings and calamities, no perſon ſuffering equal to him; he ſuppoſes himſelf a dying, when perhaps there is no great danger, while a perſon under another diſeaſe, as a conſumption, is hardly perſuaded there is danger, when he is really dying; ſometimes he is chearful, gay and agreeable; by and by peeviſh, heavy and gloomy; ſometimes 'tis impoſſible for him to keep from crying and weeping, with great extremes of grief and anguiſh; and theſe ſudden fits of convulſive crying return without the will or conſent of the patient; at other times he falls into immoderate fits of laughing and joy, which is as involuntary as the other; ſometimes he loves a perſon to deſpair, anon hates him to as great exceſs; preſently wills a thing, by and by is entirely againſt it. If theſe ſymptoms are not

ſoon cured, they ſoon terminate in hyſteric fits, epilepſy, hyp, palſy, madneſs, apoplexy, or in ſome mortal diſeaſe; as the black jaundice, dropſy, conſumption, &c. But before we enter upon the ſecond ſtage of nervous diſeaſes, we ſhall here ſtop a little, and endeavour to inveſtigate the cauſes of the ſymptoms already mentioned.

I.

A dull, heavy uneaſineſs, debility, faintneſs, yawning, gaping, and ſtretching of the arms, &c.

Theſe ſymptoms are occaſioned by a lax ſtate of the ſolids, and a deficiency of the animal æther; which is hardly able to communicate an idea of ſenſation to the ſoul. The relaxation of the fibres of the muſcles is the occaſion of the heavineſs and wearineſs of the limbs, and unwillingneſs to move; the gaping, yawning, and ſlight twitching of the nerves, and ſneezing, is a mechanical effort to throw off the offending matter.

II.

The eyes appear dull and faded; motes, clouds, or miſts, float backwards and forwards before the eyes, and the taſte is vitiated, &c.

The nervous fibres, that compoſe the membranes of the eyes, being relaxed, do not ſecrete ſo fine humours, nor make them move ſo quickly as before; therefore the patient's eyes appear heavy, and not ſo lively. Whence we ſee, why bilious and luſtful people have that ſparkling and glance in their eyes; as alſo why, in anger, fire ſeems to proceed and dart from the eyes. When the elaſticity of the fibres of the eye are much relaxed, then the ſecretions are interrupted; and the cryſtalline humours, being groſly ſecreted, attract each other, in certain points, before the retina, in too large and groſs particles, to allow of viſion. Theſe points darken ſome parts of the retina, which appear to the patient real motes. Sometimes a dimneſs of ſight, and a thick ſmoak, or miſt, before the

the eyes, proceed from a diſorder of the ſtomach. Again, when the numberleſs nervous papillæ, that make up the organs of taſte, are too lax, or too tenſe; then hot and ſpicy meats appear taſteleſs and cold, while the taſteleſs and inſipid food appears as hot as fire.

III.

Sudden and uncommon ſenſations of cold or heat, in different parts of the body, ſometimes ſuddenly ſucceeding each other, which people, ſubject to nervous diſeaſes, often feel in different parts of the body,

Are owing to the ſtagnation and ſlower motion of the fluids, in the ſmaller veſſels of theſe parts, occaſioned by the diminution of their oſcilatory motion. The ſenſation of heat in different parts of the body, which they are likewiſe ſubject to, ariſes from a contrary cauſe, viz. an increaſed oſcilatory motion in thoſe parts, from an irregular diſtribution of the nervous fluid. The languor of the ſolids, in the ſurface of the body, is ſcarce able to keep up the circulation; whereupon the

perſpirable glands are obſtructed; and the morbid matter, that ſhould have gone off by perſpiration, is thrown upon the internal viſcera; the heart is ſtimulated thereby, into quicker contractions, which drive the ſuperfluous humours upon the brain; upon which the fibres redouble their force, to diſengage themſelves; hence ariſe thoſe ſhooting pains, that dart through the head; thoſe thumping pulſes, &c. For the natural heat of all animals is owing to the regular circulation of the fluids; but when this uniform circulation is interrupted, by a ſtagnation or ſlower motion of the ſolids, or by any acrid matter, ſtimulating and irritating the nerves; then the ſmall veſſels become in a great meaſure obſtructed, or are excited into uncommon vibratory contractions. The cold ſhiverings, in the beginning of fevers, agues, inflammations, &c. are owing to the obſtructions of the veſſels, which, along with the acrimony they ſoon contract, ſo diſtend their coats, and thereby irritate the nerves into convulſive contractions, in order to diſlodge the morbid matter. Whence cold is ſoon

ſuc-

ſucceeded by heat, inflammation, ſweat, &c.

IV.

The tingling noiſe, hiſſing, and other diſorders of hearing

Are owing to a relaxation of the drum of the ear and auditory nerves; which is increaſed by damp, moiſt, hazy, overcaſt weather; and enables the patient to gueſs pretty well at the changes of weather, before it comes. It happens, ſometimes, that the fibres of the ear are too much contracted, whereby the organs become ſo acutely ſenſible, as to be ſuſceptible of the ſmalleſt impreſſion, from the leaſt breath of air; which occaſions the patient to be much incommoded from wet, hazy weather, when the air is full of moiſt corpuſcles.

V.

Lowneſs and diſpiritedneſs, without pain or ſickneſs; limpid urine, and irregularity in going to ſtool

Ariſe from a want of a free circulation and perſpiration; frequent diſcharges of large

large quantities of limpid and pale urine, are as diſpiriting and ſinking ſymptoms, as any that attend nervous diſeaſes; it is chiefly owing to an obſtruction of perſpiration; and a relaxation, and too great an irritability of the urinary veſſels; and lax, hardened, and indurated ſtools, ariſe from the ſame cauſes, viz. obſtructed perſpiration, and a relaxation of the fibres of the bowels; which impedes their periſtaltic motion, and the deſcent of the fæces; they ſoon putrify by ſtagnation, and ſend into the maſs of fluids, morbid matter, which is conveyed thither by the abſorbent veſſels. The variety of colours, obſervable in the fæces, ariſes from their greater or leſs degree of putrefaction, and the greater or leſs quantity of bile that is mixed with them.

VI.

Wakefulneſs, and want of ſleep

Ariſe from the nervous fibres of the brain being continually in motion; which keeps the faculties always attentive to thoſe perceptions, that ſucceſſively enter by any of the ſenſes. For it is neceſſary to procure a ſound

a ſound ſleep, that the nerves of the brain abate of their motion; and this abatement is deſigned to reſtore them to their proper elaſticity. As want of ſleep is a very troubleſome, diſpiriting, and weakening ſymptom; therefore we muſt, by all means, endeavour to procure reſt. We ſee that thro' the conſtant impulſes, that exerciſe the nerves, and through much attention to any buſineſs or ſtudy, a perſon finds himſelf heavy; becauſe, by the conſtant exerciſe of the animal æther, in conveying impulſes to the ſoul, of every object that preſents itſelf, in the day, the nerves loſe their elaſticity, the animal æther is much waſted, and circulates more languidly. But ſleep is deſigned to recover the elaſticity of the nervous fibres, and ſo it does; for the ſecretions being more plentifully performed in bed, the nerves are thereby nouriſhed and reſted, and recover their former briſkneſs with the day. Hence we ſee the uſe of long ſleep to nervous people; but when they have been ſome time under that complaint, they ſleep little, and ſeldom without dreaming; becauſe the impulſe conveys ſenſation

ſation to the ſenſorium too briſkly, and overpowers the inclination to ſleep; and the nervous fibres, that compoſe the ſeveral organs of ſenſe, are ſo ſtrongly agitated in the time of ſleep, as to make the ſoul attentive to the ideas theſe motions repreſent. For, in dreaming, the organs of ſenſe have a power to revive ideas, that depend not upon the immediate preſence of objects, but upon the degrees of their mechanical motions; for theſe motions, being increaſed in the organs, are alſo, from the ſame laws of mechaniſm, increaſed in the nervous fibres of the brain; whereby they raiſe a perception of any object they are capable of conveying. If we dream of banquets, then the nerves of taſte are chiefly affected, &c. Theſe deluſive perceptions may affect the perſon, when awake; for there are certain perceptions of objects, which always appear to the ſoul, when ſuch and ſuch degrees of motion, are communicated to the ſenſorium.

VII. *Fre-*

VII.

Frequent rifts, belchings, hiccups, croaking and murmurings in the bowels, heart-burn, inflation of the ſtomach, vomiting of corrupted bile, tough phlegm, and ſour acrid matter, wandering pains, &c.

When the coats of the ſtomach are relaxed, their muſcular motion is impeded; the food is ſlowly and imperfectly digeſted, and the chyle is not with ſufficient force thrown into the abſorbents: what remains in the ſtomach longer than the laws of the animal œconomy require, breeds crudities, acrimony and wind. For all our aliments, eſpecially thoſe of the vegetable kind, abound with air; which, by the fermentation and putrefaction, it undergoes in digeſtion, is ſeparated, gets vent, and produces that flatulence or wind, which many people, not nervous, are troubled with. Indeed, ſtrong and healthy people are ſeldom troubled with wind, unleſs they eat too much, or of too heavy ſolids, or drink of fermenting liquors: in this caſe, the viſcera being ſound and elaſtic,

and the nerves endowed with a due degree of ſenſibility, the digeſtion is regularly and uniformly carried on; and the aliment does not lie ſo long as to ſeparate ſuch a quantity of air, as to give any trouble. But when the ſtomach is much relaxed, and the ſaliva and other juices, in ſome degree of putrefaction; then there ariſe many and various complaints, ſuch as want of appetite, *nauſea*, faintneſs, low ſpirits, watchings, ſwelling of the ſtomach and bowels, with violent and excruciating pains in them; tightneſs and oppreſſion about the *præcordia*, difficult breathing, a ſenſe of weight at the ſtomach, belching, *globus hyſtericus*, giddineſs, ſhooting pains in the head, &c. if the wind gets vent by the ſuperior orifice of the ſtomach, it goes off in hot, ſour and acrid belchings, rifts and hiccups; but if the acrid *myaſma*, or corrupted ſteam does not make good its way by the mouth; then it deſcends into the bowels, and produces ſpaſms, flatulencies in the primæ viæ, and ſtrange grumbling and murmuring in them. The firſt ſcene is acted in the ſtomach, which, from indigeſtion, produces wind and acrimony, which

are

are the cauſe of the greateſt, moſt painful and frightful ſymptoms in all the ſtages of nervous diſeaſes. When the aliment lies in the ſtomach longer than is conſiſtent with the laws of nature; then, by the heat, hurry, and tumult of the bowels, a great quantity of wind is generated; which, being incloſed and heated, and, of its own nature, tending to putrefaction, ſoon becomes acrid, like ſtagnant air, but more ſo, as being more confined; and the longer the chyle lies in the ſtomach and inteſtines, without being taken up by the abſorbents, the greater quantity, ſharper, hot-hotter and more acrid will the *myaſma* be. Theſe windy pains, which may be commonly obſerved to be greateſt ſometime after a full meal, or before an hyſteric paroxyſm, do not confine themſelves to the *primæ viæ*; they occaſion a *cardialgia*, which is a moſt exquiſite pain in the pit, or ſuperior orifice of the ſtomach, a weakneſs, trembling of the limbs, wandering pains, ſwelling of the hypochondres, &c. Theſe ſymptoms ariſe from this acrimony being received by the abſorbents, and by them car-

ried into the blood, and with it through the whole habit. Theſe ſudden ſtartings are not owing to the flatus taking ſuch ſudden flights, as appears to the patient; but to the contraction of the nerves in divers places. As ſoon as the working and contractions of the fibres have removed the obſtruction, and diſlodged the offending matter, in one part; then the fibres, in another part, perhaps, at a conſiderable diſtance, contract themſelves; upon which the patient perceives the pain to ceaſe in one place, and to ariſe in another, and is apt to think that the pain is locally removed.

Dr. Cheyne obſerves, that he never ſaw a perſon under ſevere and obſtinate nervous complaints, but he always found at laſt, the ſtomach, ſpleen, liver, meſentery, or ſome great organ or gland of the lower belly obſtructed, knotted, ſchirrous or ſpoiled, or perhaps all theſe together: or any habitual, grievous or great nervous diſorder, ever happen to any perſon, who did not labour under ſome real glandular diſtemper, either *ſcrophulous* or *ſcorbutic*, original or acquired.

The

The ſtomach is often, ſays he, the firſt and principal organ in fault; it may be naturally weak and thin; or worn out with luxury and debauch; its coats may be relaxed, ſoft and flabby, or its glands may be ſchirrous and knotted; from whence ariſe *impoſthumes, cancers, gangrenes*, &c.

VIII.

Uneaſy cravings, faintneſs, giddineſs, painful ſpaſms, nauſea, vomitings, with many of the foregoing ſymptoms,

May ariſe from aliments improper in their quality as well as quantity. The moſt wholſome food, in too great a quantity, oppreſſes the ſtomach and bowels; and being improperly digeſted, becomes acrid, putrid, and generates much wind; whence the complaints already enumerated. On the contrary, the want of a due quantity of aliment, occaſions faintneſs and wind; and, in time, ſo much weakens the ſtomach and bowels, as to render them unfit to receive or digeſt what is neceſſary for ſupporting the body. The quality of the food may

may offend: thus high ſeaſoned meats, ſtrong ſauces, &c. will not only gradually enervate the tone of the ſtomach, but pervert and deſtroy the natural feeling of its nerves, corrupt the blood, perhaps breed arthritic pains, and bring on a diſeaſed ſtate of the whole body. Beſides, a watery and flatulent diet, by generating much wind, and not affording proper nouriſhment, will occaſion many complaints, chiefly in thoſe that are ſubject to ſuch diſorders; but will ſeldom give uneaſineſs to thoſe whoſe ſtomachs and bowels are ſtrong.

IX.

Want of appetite, nauſea, cramps in the ſtomach, vomiting ſometimes black or bloody coloured matter, cold ſweats, low ſpirits, flatulence. Nervous atrophy or weakneſs and thinneſs of habit, tending to hectic heats, eſpecially after meals, oppreſſion, &c.

Are owing often to ſchirrous or other obſtructions in the ſtomach, liver, inteſtines, ſpleen, pancreas, meſentery, uterus, ovaria, &c.

&c. which hinder the free and eaſy paſſage of the chyle into the lacteals. As the meſentery is the baſon for the chyle, ſo when it is obſtructed, the further preparation of the chyle and its courſe to the thoracic duct are interrupted. When the guts are ſcirrhous, the free play of their periſtaltic motion is hindered; the excrements are impeded in their diſcharge; and the morbid, thin part, by their ſlow deſcent, is again abſorbed and mixed with the blood. Obſtructions in the ſtomach, hinder the digeſtion; in the liver and ſpleen, impede the ſecretion of the bile; and, by their weight, occaſion a diſagreeable ſenſation. Obſtructions in the ſtomach and liver, are often the occaſion of low ſpirits; ſo, on the other hand, melancholy or long continued grief, frequently give riſe to hypochondriacal and hyſterical complaints, and ſometimes obſtructions and ſchirruſes in the viſcera, mammæ, &c. From ſuch a ſtate of mind, not only diſorders of the nerves, of the ſtomach, liver and other bowels; but alſo want of appetite and digeſtion, ſpaſmodic contractions and irreſolvable obſtructions, and ſchirruſes in the breaſt, which have often turned

to

to a cancer. The dark brown or blackiſh coloured blood vomited up, commonly proceeds from a ſchirrous ſtomach, with ſmall ulcerations and chops; in which caſe we condemn the too common and fatal practice of giving ſtrong and frequent emetics; the patient ſhould drink nothing but hot water, or a decoction of camomile flowers to procure a puke. It may alſo ariſe from violent pains or cramps of the ſtomach, or from a ſuppreſſion of the menſtrual purgations or hæmorrhages.

Nothing produces more ſudden or ſurprizing changes in the body, than violent affections of the mind. Horrible and unexpected ſights, great grief, terror, anger, &c. will throw a perſon into hyſteric fits, convulſion, &c. Long and continued grief will weaken the tone of the ſtomach, deſtroy the appetite and digeſtion, occaſion thirſt, and impair the memory and judgment. Sudden fear will cauſe a paleneſs of countenance, univerſal debility and ſhaking, palpitations of the heart, anxiety at the breaſt, difficult breathing, looſeneſs, vomiting, pale urine. Anger raiſes the pulſe; quickens

quickens the circulation, and occaſions a temporary fever, with great heat. Sometimes violent paſſions have thrown delicate women into a kind of *teanus* or catalepſy, when the patent becomes either wholly or in a great meaſure inſenſible, and remains exactly in the ſame poſture; others have died of thoſe paſſions.

X.

Want of appetite, ſometimes an unnatural craving for food, a nauſea, flatulence, gripes, looſeneſs, weakneſs, fainting, lowneſs of ſpirits, ſleepineſs, ſighing, convulſive motions, giddineſs, inflations of the alimentary canal, hiccup, vomiting, dry cough, difficult breathing, irregular pulſe, palpitations, &c.

All theſe ſymptoms, may ariſe from tough phlegm in the primæ viæ, or from worms, &c.

In the alimentary canal, there are ſmall glands, which ſecrete a glutinous liquor, deſigned to defend the delicate nerves from the heat, cold, acrimony or attrition of the food; but

but when theſe ſecreting veſſels have loſt their tone, and are affected with an unnatural ſtimulus, not only the mucous glands, but alſo the exhaling arteries, throw out, in a greater quantity, a viſcid fluid; which, by lying ſome time, acquires a greater degree of coheſion.

When much phlegm is collected in the ſtomach and inteſtines, their nerves are leſs ſenſible; the abſorbent veſſels are plaiſtered up and much obſtructed: whence digeſtion is ſlowly and imperfectly performed; and the chyle is not ſufficiently abſorbed by the lacteal veſſels; which occaſions the above ſymptoms. Worms too in the primæ viæ, eſpecially in children, by preventing the regular digeſtion of the food, and by biting and irritating the nerves, produce the ſame ſymptoms.

XI.

A nervous or ſpaſmodic aſthma.

Every difficulty of breathing, is called an aſthma, whether it ariſes from tough phlegm, ulcers,

ulcers, ſcirrhuſes, or ſpaſmodic contractions of the lungs; the laſt is, what is properly called the nervous aſthma, and ariſes from obſtructed perſpiration and indigeſtion; whereby the ſteams and inſenſible perſpiration are thrown back into the cavity of the body, and the lungs being naturally tender and very ſenſible, are affected with ſpaſmodic contractions, by any acrid or noxious matter, whether arthritic, rheumatic, putrid, &c. A tranſlation of the gout from the foot, will cauſe a nervous aſthma; the diſcharge of a flatus, from indigeſtion, will give preſent eaſe; a full perſpiration will do the ſame, and a ſudden diminution of it will bring on ſpaſmodic cholics, aſthmas, &c.

XII.

A nervous cough.

A cough is called nervous, that does not proceed from any phlegm, obſtruction, or other irritating cauſe in the lungs themſelves; it is a tickling, dry, convulſive cough; which ariſes from wind, preſſing upon the dia-

phragm; which is thereby forced up upon the lungs. It may alſo ariſe from an acrimony in the blood; from obſtructed perſpiration, eſpecially of the feet or arm pits; from worms; from ſome fixed obſtruction in the lungs; or from too great a delicacy of thoſe parts.

XIII.

The variation of the pulſe, and palpitation of the heart.

Theſe ſymptoms proceed from a great variety of cauſes, too tedious to mention here; the general cauſes, however, are the different ſtates of the fluids and ſolids, which I have already conſidered and largely inſiſted upon, in my new ſyſtem of phyſic.

XIV.

Spitting or ſalivation.

This ſymptom proceeds from obſtructed perſpiration, and is commonly a critical diſcharge, or follows ſome exceſs in diet, and ought never to be ſtopt, but forwarded: if

it

it is exceeding plentiful with ſickneſs, reaching, and head-ach, you may give a vomit, to promote the diſcharge, quicken the circulation, and promote the perſpiration.

XV.

Periodical head-achs.

Theſe affect all the head, the fore or back part, one ſide, or one particular part, perhaps not the ſize of a ſhilling: Sometimes the temples are affected, at other times only one eye. They generally obſerve regular paroxyſms; the pain is often very acute, overcomes and ſinks the patient very much; ſometimes the eyes ſwell or ſink, and generally loſe their luſtre; the patient looks as if he had watched too long, or drank too much. The cauſe of theſe head-achs is an uncommon ſenſibility in the nerves of the head; a weak and imperfect digeſtion; a foul ſtomach, and acrid matter generated thereby; obſtructed perſpiration; or to a rheumatic, gouty, or ſcorbutic humour, &c. and perhaps to all theſe cauſes put together.

XVI. *Sink-*

XVI.

Sinkings, lowneſs, ſadneſs, fits of crying.

Theſe ſymptoms ariſe from a great depreſſion and relaxation of the nervous fibres, and the languid circulation of the animal æther; the optic nerves, and glandulæ lachrymales, which contain the lymph that form the tears, being relaxed, are unable to hinder them from being protruded into the eyes; and if they are much relaxed, and unable to contract, and continue ſome time in that ſtate, there is a fiſtula lachrymalis formed, near the great canthus of the eye.

XVII.

Immoderate fits of laughing, &c.

Immoderate fits of laughing, upon trifling occaſions, when perhaps the ſame cauſe would, a little after, hardly be able to raiſe one laugh, or move one muſcle of the face into contraction, are always a ſign of weak nerves, and may be truely called a paroxyſm, or fit, which is an effort of the nerves, to diſengage themſelves entirely of

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all oppreſſive matter, which their weakneſs has occaſioned; they are put upon this, becauſe the ſoul perceives ſome of the finer obſtructions to give way, which raiſes a pleaſing idea, and is diſcovered in laughing and good humour. But if the nerves are worſted in the conflict, and are unable to remove all the obſtructions, they are left weaker than before; and, accordingly, we ſee the laughing fit is ſucceeded by lowneſs, anſwering to the ſoreneſs, numbneſs, &c. that follow hyſteric fits. So that nervous diſeaſes, from their earlieſt beginnings, have their exacerbations. When the nerves are relaxed, they give an idea of ſinking, or ſadneſs, to the ſoul, and produce what we call lowneſs of ſpirits, fears, dejections, and horrors: But, in conſumptions, the muſcular, fleſhy parts decay, and ſuffer firſt; and that decay, coming on gradually, ſcarce gives the ſoul notice of it; therefore the patient fancies himſelf in little danger.

CHAP.

CHAP. II.

OF THE CURE OF NERVOUS DISEASES.

IN vain have we found out the cauſes of nervous diſeaſes! in vain have we enumerated their ſymptoms! if we can find no method of curing them. The poor, haraſſed, tortured, and diſtracted patient, will give us little thanks, for all we have done, if we cannot ſay do ſo and ſo, and be cured: 'tis when the captive victim is ſet at liberty, that he rejoices. We ſhall now lay down the rules of practice, that the ſuffering patient may have cauſe to thank us for our trouble.

When I ſet out upon this ſubject, I propoſed to endeavour to prove, that man is made up of two parts, *matter and ſpirit, or ſoul and body*, cloſely connected to each other: I alſo endeavoured to ſhew the nature and manner, in which that connection is kept up; that the immaterial part

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has faculties, the free and regular exercise of which, depends on the laws of matter and motion, i. e. on the assistance of the corporeal organs, fitted or mechanized to an exact standard; that the immaterial part accompanies the material through all its changes; and that these changes arise in the corporeal organs from divers causes, &c.

Now I come to the method of restoring a constitution, labouring under any of the foregoing symptoms; and the certainty of doing this depends upon the certainty of the theory; but the certainty of the theory depends upon intuition, which is the most certain and infallible evidence, any matter is capable of; as I have already proved.

Having therefore carefully observed the external, visible, obvious, sensible qualities, we get a rational knowledge of the internal, irregular motions of the solids and fluids; which disconcert the body, and produce these qualities.

Therefore in order to cure a disease, we must endeavour to increase or lessen these

motions, according as they are above or beneath the ſtandard of health; which we do by intending or remitting the action of the ſolids and fluids, ſo that the defective qualities may prevail, and the abounding humours paſs off, by ſome of the natural diſcharges: thus we accompliſh a cure, which would always be the caſe, if we properly diſcharged our duty.

Theſe nervous diſeaſes would not be ſo difficult of cure, nor would the patient ſo often relapſe, if there was a proper method obſerved, and all the intentions of cure properly attended to, and long enough continued. When we endeavour to thin or thicken the blood, we neglect at the ſame time to reſtore the ſolids, upon whoſe motions the well being of all the juices and ſecretions depend. When the blood and other juices are reſtored to a due conſiſtence, if the languor remains on the ſolids, they will be unable to preſerve the fluids from runing into unnatural coheſions, upon which the complaint returns, and acts over again the ſame ſcene.

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When we ſay ſuch a caſe is difficultly cured, the meaning or reaſon is, we are ignorant of the laws of nature, which produce theſe effects, and the cauſes that excite theſe ſymptoms; conſequently the indications to be purſued, for the obtaining a ſucceſsful cure, lie hidden from us. Many will be ready to deny this, by ſaying, that numberleſs diſeaſes remain incurable; the medicines, curing a diſeaſe in one perſon, fail in another; nay, that the medicines fail of ſucceſs in one perſon, upon a relapſe. To this I anſwer, that in the nature of things, the ſame effects muſt neceſſarily ariſe from the ſame cauſes, acting in the ſame given circumſtances; conſequently, the ſame effects will always flow from the ſame adminiſtrations, acting in the ſame given circumſtances. It would be confounding all the laws of nature and certainty, by which we judge of the truth of things, to ſay, that medicines, in their operations, are not conſiſtent, ſteady and regular. To ſay that the ſame cauſe does not always produce the ſame effect, in the ſame given circumſtances, is to deny experience,

matter of fact, and the teſtimony of all men of ſenſe. Therefore, if the ſame applications, that cured a diſeaſe before, don't do the ſame upon a relapſe, 'tis a ſure indication, that the ſymptoms vary now from what they were before. Symptoms vary every moment, conſequently, are not the ſame, upon a relapſe, they were in the original diſeaſe.

In order therefore to be ſucceſsful in curing diſeaſes, we muſt (after knowing a ſet of proper remedies, and certain principles to ground their operations upon) have a criterion, by which we are enabled to judge of the particular conſtitution of the patient; when we are maſters of theſe, we eaſily judge of the proper circumſtances of application. Knowing therefore the particular conſtitution, at that time predominant in the patient's habit, which we know by intuition, from the external, viſible, ſenſible qualities, which are different in every individual, even in the ſame diſeaſe, according to the age, ſex, conſtitution, and time the diſeaſe has been already upon the habit, then we are able to judge of the proper do-

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ſes of medicines. Indeed, if the diſeaſe is ſo faſt rivited on the habit, and the conſtitution ſo weak or impaired, as not to be able to bear the force, that is neceſſary to remove the offending matter; then the diſeaſe is incurable, and death comes on ſooner or later, in proportion to the quantity of offending matter, and weakneſs of the conſtitution.

Having therefore ſeen that the phyſician is inabled to act upon the moſt ſteady, certain, and undoubted principles; we ſhall now conſider what is to be done to obtain a cure in *nervous diſeaſes*.

Firſt then we are exactly to regulate the uſe of the non-naturals; for in vain do we preſcribe medicines, if the patient is not directed and willing to obſerve certain regulations, in relation to *air, diet, and exerciſe*. We ſhould chuſe a free open air, not incumbered with hills or woods; a cool and dry air, brace and invigorate the whole body; and hot, confined, and damp air, weakens and relaxes the habit. When the

ſtomach

ſtomach and bowels are weak, they ſhould be well guarded againſt cold and damps, eſpecially in winter; and there is no dreſs better and more neceſſary to keep up a due perſpiration, than flannels worn next the ſkin.

Conſtant exerciſe, every day that allows of it, either in walking, on horſe-back, or in an open chaiſe, is of vaſt ſervice; it ſhould be as much as the ſtrength will admit, without weakneſs, fatigue, or hurry; never weary yourſelf, nor raiſe a ſweat; go no further, than you can return with as much ſpirit as you went out. Exerciſe ſtrengthens the whole nervous ſyſtem; aſſiſts digeſtion, (but retards it after a full meal; therefore after dinner ſit a while) ſanguification, and the diſtribution and ſecretion of all the animal fluids. By muſcular motion, the blood and juices are kept in a due ſtate of fluidity; their viſcidity is broken and diſſolved, and all obſtructions either prevented or removed. The fleſh bruſh is an excellent thing for ſtrengthening the ſolids; as friction, either with the fleſh bruſh, flannel, or coarſe linen cloth, ſtrengthens

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the body, promotes the circulation, and is particularly uſeful in weak bowels.

People of weak nerves are generally quick thinkers, from the delicacy of their ſenſitive organs, which are therefore more liable to be fatigued and relaxed with exerciſe, than thoſe of a coarſer make; whence we ſee the neceſſity of keeping the mind eaſy, quiet, and chearful; ſince nothing hurts nervous people more, than fear, grief, and anxiety. Uſe therefore agreeable amuſements, and a little ſlight, entertaining and diverting reading, that requires no thought; for all ſtudy is pernicious and hurtful. Converſation ſhould be agreeable, trifling, and eaſy, without diſpute or contradiction; amuſements be innocent, various, and not expenſive; otherwiſe, upon reflection the money laid out would do more hurt, than the amuſements could recompence. In a word, all thought and care muſt be laid aſide; and rationality muſt give place, for a while, to a way of life, which BATH gives a pattern of.

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I cannot but highly approve of a practice there, of having muſic, while the patients drink the water; which has a very great and good effect upon the motion of the finer animal fibres. Muſic has been allowed, in all ages of the world, to have a noble power in raiſing the dejected ideas of the ſoul. Thoſe that have the moſt delicate conſtitutions, are moſt ſenſible of its good effects: it opens the obſtructions of the fineſt veſſels; aſſuages the paſſions, and at the ſame time communicates a pleaſure to the ſoul, and makes its ideas chearful, gay, and lively; by the oſcillatory motion of the air, vibrating againſt the timpanum of the ear, there is ſuch an impulſive motion given to the fineſt fibres of the brain (upon which the ſoul more immediately diſplays its faculties) as to enable them to bring regular impulſes to the ſenſorium.

But though muſic reſtores the tone of the fineſt fibres of the brain; yet the inferior organs demand coarſer treatment, to reſtore them to the ſtandard of health.

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We muſt abridge the quantity and quality of our food, which ought to be nouriſhing, eaſy of digeſtion, and ſuited to the ſtomach of the patient. Fat meats, and heavy ſauces, are hurtful; and all exceſs is to be avoided. The patient ought never to eat more than the ſtomach can eaſily digeſt: eat therefore little at a time, but often, of innocent, plain, and ſimple meat; for every time the ſtomach is over-loaded, the ſtrength is impaired, and its nerves are diſordered.

Above all things, heavy ſuppers ought to be avoided; ſince the ſtomach is much more apt to be oppreſſed with the ſame quantity of food, in an horizontal poſition, than in an erect poſture; and ſince the digeſtion goes on ſlower in time of ſleep than when awake, as the veſſels are then much relaxed.

It is a great bleſſing, that loathing and inappetency, in ſome degree, attend all diſorders; which prevent many people from infallibly and quickly ruining themſelves

without reſource. Thoſe who have only a few tranſient ſymptoms, and are but in the firſt ſtage of nervous diſeaſes, ſhould live with a due degree of temperance, ſuited to their conſtitution; and abate a little of the quantity of their food, while they are more immediately under the ſymptoms. Indeed, if the diſorder is deep, and hath continued ſo long as to produce more violent ſymptoms, then there is a neceſſity to be ſtill more careful.

Drink ſmall beer, ſoft fine ale, or wine and water; but never uſe water alone. Wine in exceſs enfeebles the body, and impairs the faculties of the ſoul; but a few glaſſes of wine, in time of eating, aſſiſt digeſtion. A glaſs of wine, before dinner, on an empty ſtomach, and when one is languid, feeble, or faint, is of great ſervice. Wine, in general, is preferable to malt liquor; the beſt wine is rheniſh, mountain, or ſmall French wine. When the ſtomach and bowels are troubled with acidity, water mixed with rum or brandy, is preferable to wine, or malt liquor. That too common

drink

drink *Tea*, is very hurtful, both to the ſtomach and nerves, eſpecially if drank hot, with little bread: I would therefore recommend, not the diſuſe, but the more moderate uſe of *tea*: it were well, if ſomething elſe was joined with it in the morning.

Having now laid down the neceſſary preliminaries, I ſhall next mention the medicines, and form of adminiſtration.

We ſhould never bleed, unleſs we have manifeſt indications, ſuch as convulſive coughs, ſharp acute pains; and, in ſanguine, bilious conſtitutions, where there is a plethora, &c. but never exceed eight or ten ounces; for bleeding weakens and relaxes the contractile force of the fibres, and impairs the motion of the blood and animal æther.

Vomiting is of wonderful uſe, when the viſcera are ſound, and no ſchirrous knots formed in the veſſels; it diſcharges the choler and viſcid phlegm; and, from the

advantageous ſituation of the ſtomach, gives a great turn to ſeveral chronical diſeaſes, ſituated in the lower parts of the body: By its action, and the force of ſtraining, it opens the obſtructions in the moſt remote parts; it ſhakes the habit, and pumps, from the moſt extreme parts and inmoſt receſſes of the body, thoſe humours which cannot be reached any other way; and frees the greater organs of their obſtructions and morbid matter.

Vomits enable us to give the moſt quick and effectual relief to violent paroxyſms, and very greatly to mitigate their ſymptoms; till, by the uſe of proper medicines, the diſeaſe quite diſappears. As emetics act by their ſtimulus, ſo they raiſe the pulſe, and promote a diaphoreſis; and are of great uſe in languid caſes. Therefore we are not only to uſe them in the primary preparations, before we enter upon the regular courſe; but at any other time, when the ſymptoms indicate, or the violence of the paroxyſms require a mitigation. Phlegm and bile are moſt effectually evacuated by

ſquills;

ſquills; and nothing proves a better diaphoretic than an antimonial emetic. For young and weak conſtitutions, and where there are ſchirruſes formed, warm water, decoctions of camomile flowers, or a few grains of *ſquills*, will prove ſufficiently ſtrong; and theſe are not to be often repeated. But if the conſtitution is ſtrong, and the viſcera ſound, you may often give antimonials with great ſucceſs; they are the beſt which mildly operate both ways: the ſame night, at bed-time, always give the camphorated julep, *vin. antimon.* with ſome ſimple water, and *ſyr. e mecon.*; or *theriac. androm. ipecacoan. gr.* 3.; or *emetic tartar*, qr. $\frac{1}{2}$ to 1, &c.

I always begin the courſe with a gentle emetic, which operates both ways; unleſs there be indications to forbid vomiting, as great weakneſs, ſmall veins, ſtrait cheſt, long neck, bilious conſtitution, &c. and then I clear the *primæ viæ* by a purgative.

If the conſtitution is hot, dry, and bilious, the purge ought to be gentle, cooling,

ing, and relaxing, as *Epſom* and *Glauber's ſalt*, *cream of tartar*, *caſſia*, *manna*, *ſena*, &c. to aſſuage the heat, check the hurry and motion of the blood, and evacuate the bile. As the bile is troubleſome in all nervous and lax habits, I take care, through the whole courſe, to evacuate it, whenever it begins to abound; for if you keep the body free of bile, you greatly haſten the cure; and nothing diſcharges the bile more effectually, and with greater eaſe to the patient, than *infuſion of ſena and tartar emetic*, gr. 1.

In a cold, phlegmatic conſtitution, where the contractions are weak, and the fluids languid in their motions, I give *tinctura ſacra*, *elix. proprietatis extract. rudij.* &c. In this caſe, we are always to omit bleeding, but a vomit is of ſervice.

If there is a great ſtupor, and heavineſs of the head, which the vomit, when repeated, does not remove, then we muſt bleed in the foot; cup, or ſcarify the neck or ſhoulders; or apply leeches to the tem-

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ples; bathe the feet conſtantly every night, and apply cataplaſms to the ſoles of the feet.

Fomentations and a warm bath to the feet, ſays Dr. Whytt, are particularly uſeful in fevers, where the brain and nervous ſyſtem are much irritated: in caſes where the eyes are inflamed, they will anſwer better, if the patient has been bled in the temples with leeches, before their application. When the ſick cannot bear the pediluvium in an erect poſture, he may have his legs put over the ſide of the bed, ſo as to be immerſed in the warm water. I ſhall only add, ſays the learned doctor, that I have found the warm *ſimicupium* or *pediluvium* the beſt remedy for thoſe convulſions, which ſometimes precede the eruption of the ſmall-pox: and for the general tremor of the whole body, which often happens towards the end of the diſeaſe, when the puſtules are of a very bad kind.

When the head is affected, nothing gives greater relief than bliſtering the back part of it, and having a perpetual bliſter to the nape of the neck, or an iſſue in the ſhoulder; indeed bliſters are of wonderful ſervice in all

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nervous caſes, whether the head is much affected or not; the uſe of them ſometimes cannot be diſpenſed with.

If there is a ſuppreſſion of any natural diſcharge, we muſt by all means endeavour to bring a return. When the *menſes* are obſtructed, we muſt promote their return, and till that is done, the moſt troubleſome ſymptoms are to be palliated. There are few caſes in which we are oftener diſappointed, than in bringing back the monthly evacuations, after they have been long ſuppreſſed; and the medicines proper in one caſe, prove often ineffectual, ſometimes hurtful, in another. When the want of blood, is the cauſe that the menſes do not flow; the beſt remedies are the bark, bitters and ſteel, with a nouriſhing diet and exerciſe; when the patient has by this means got blood, it ſhould be determined to the uterus, by frequent doſes of *tinctura ſacra, elix. proprietatis, pil. gummos.* and by bathing the feet and ſitting over the water. If a *pelthora* prevents the menſes, then bleed in the foot; the pediluvium and a gentle purge will prove effectual. If the thickneſs and viſcidity of

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the blood, is the cauſe of the obſtruction; then frequent vomits, the *pilulæ mercuriales*, laxatives and gentle purges with *calomel* will anſwer. If the ſuppreſſion of the menſes, is owing to ſpaſmodic contractions of the uterine veſſels, then the *pediluvium*, *fomentations*, *oily draughts*, *pills of aloes*, *aſafœtida*, *extract of black hellebore and ſaffron*. *pul. ari. c.*, *elix. proprietatis*, *tinct. ſacra pil. gummos.* *glyſters of warm water*, *with laudanum.* Dr. Whytt ſays, that he uſed, with ſucceſs, the following remedies, in caſes where the menſes were leſs copious than uſual.

℞ Aloes ſocotorin. as. fœtid. extr. hellebor. nigr. ſal. mart. croci angel. āā ʒ1 elix. proprietat. q. s. ut pil. gr. 4 quarum capiat 5 vel 6 alteris noctibus.

℞ Rad. gentian. calam. aromat. āā ʒ1 ſummit. centaur. min. 36. flor. anthos ʒ2. m. f. materialia infunden-da, pro hor. 6. in aq. bullient. ℔4. colatur. adde tinct. cort. peruvian. ʒ10 m. cape ʒ3. biſ in die.

Theſe medicines are to be uſed two or three months, with the pediluvium at bed time.

At the decline of life, when the menſes begin to ceaſe, frequent ſmall bleedings, gentle ſtomach purges, and iſſues are of uſe.

If the hæmorrhoidal flux is wanting in thoſe who have been accuſtomed to it, we muſt endeavour to recall it with *fomentations, aloes, leeches applied to the anus, or by the uſe of the lancet.*

If old ulcers or ſores have been too quickly dried up, then you muſt purge off the offending humours, or carry them off by means of iſſues and ſeatons. If pimples and other eruptions on the face, &c. have been injudiciouſly repelled, the conſequence often is violent head-achs, giddineſs, ſickneſs at the ſtomach, palpitations, &c. In ſuch caſes, if the morbid matter cannot be brought back to the face, it muſt be carried away by *perpetual bliſters, iſſues, and by mercurial purges, antimonials, diapharetics,* &c.

If there is an immoderate flow of the menſes, it is reſtrained by *bleeding, tinct. roſar.*

rosar., *terra japonic.*, *alum.*, *opium*, *elix. vitriol.* &c. as,

℞ Lact. recent. bullient. ℔ 1 alum. rup. pulverat. ʒ 1 ad. ʒ ſs m. f. coagulum et ſero colato. adde ſacch. alb. ʒ 1 cape ʒ 3 vel 4 in die.

vel

℞ Aq. menth. ʒ 6—cinnamom. ſ. v. ʒ 4 confect. japon. ʒ 6 ſyr. limon. ʒ 2 m. cap. cochl. 2, 4ta vel 6ta quaque horâ.

Anodyne clyſters are of great ſervice in *floodings*, &c. The *fluor albus* has been cured by *ſea bathing*, when other medicines have failed. The following is often attended with ſucceſs.

℞ Cart. aurant. ſevil. recent. integr. 7 coque ex aqu. fontan. ℔ 3 ad. 2 calaturæ adde ſacchar. alb. ʒ 1 elix. vitriol. gut. 60 cape chocl. 6, 3tia quaque die.

If the excrements are hard, and the body coſtive, uſe *ſal. prunel.*, *crem. tartar.*, *ſal. glauber.*, *ol. amygdal.*, *ol. palmæ chriſti*, &c. as,

℞ Ol. amygdal. dul. ʒ2ſs. ſyr. viol. ʒ2 flor. ſulph. ʒ2 m. cap. cochl. 1, 4ta quaque hora pro re nata.

vel

℞ Extract. caſſiæ ʒſs. calomel ℈1ſs. ol. ſem. anis. eſs qut. 3 crem. tartar ʒſs. m. f. elect. D. q. n. m. in ſeptimanam ſuperbib. ſeri lactis ℔ſs.

vel

℞ Decoct. commun. pro enemat. ʒ10 mel. ſolutiv. ʒ2 elect. lenat. ʒ1ſs. ſal. gem. ʒ3 m. f. enema.

As the patient, under nervous diſeaſes, is always affected with wakefulneſs, I take care to ſecure the tranquillity of the ſleep, by *theriac. andromac.*, *tinct. thebaic.*, *elect. e ſcordio*, &c. with *cordials* and *diaphoretics*, as,

℞ Camphor. gr. 8 tartar. emetic. gr. 1. elect. e ſcordio ℈1 m. ut f. bolus.

vel

℞ Pulv. ipecacoan. gr. 3 ſal. ſuccin. gr. 4. theriac. androm. ʒſs. m. f. bolus.

I very often give eight or ten grains of the *ſoap* pills with a few grains of *camphor*, or the following draught.

℞ Aq. puleg. ſimp.—Caſtor. āā ʒſs. ſp. lavendul. c. ʒi ſyr. e meconio ʒ1 m. f. hauſtus. cap. omni nocte hora ſom.

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℞ Extract. thebaic. gr.iſs theriac. androm. ℈1 m. f. bolus cap. hora ſom. ſuper.

vel

℞ Aq. cinnamom. ſimp. ℥2 aq. cinnamom. ſpt. ℥1 extract. croci gr.3 confect. alkerm ℈1 m. ut f. julep.

Or

℞ Pulv. occul. ♋ c. ℈1 croci pulv. ſal. ſuccin. āā gr.3 ſyr. e meconio q. s. bolus ſuperbit.

℞ Aq. menth. vulg. ℥2ſs. ſyr. croci ʒ3 laud. liquid. qnt.20 m. f. hauſtus.

No medicine is of greater uſe, as a palliative in all ſtages of nervous diſeaſes than *opium*; it eaſes pain, and gives ſudden relief, and muſt be run to on all preſſing occaſions. Sometimes 'tis impoſſible to procure eaſe without it; it is of wonderful uſe in ſpaſms, convulſions of the muſcles, and in all acute pains; procures reſt, and makes the nights comfortable; and is of particular ſervice in too great a delicacy, and ſenſibility of the nerves; it relaxes the ſolids and fibres of the nerves; retards the motion of the juices; ſlackens the ſecretions, and brings a languor on all the organs; as we ſee in giving it unſkilfully, in groſs corpulent habits, in humoral

moral aſthmas, coughs, &c. When given in too large quantities, it leſſens the ſenſibility of the nerves, the ſtrength of the body, and the faculties of the mind: ſometimes it brings on a faintneſs and languor; ſtartings of the tendons, ſickneſs, vomiting, cramps, itching over all the body, redneſs of the eyes, horrors, raving and madneſs. The continued uſe of opium ſeldom fails to bring on coſtiveneſs, and loſes its virtue and efficacy in unſkilful hands; it thickens the juices to ſuch a degree, as to render it impoſſible, or at leaſt very difficult to make a cure; locks up the humours on the bronchial glands, and thereby chokes the patient, before medicines have time to give relief. I know it has been, and ſeems to be ſtill by ſome ſuppoſed, that opium raiſes and accelerates the pulſe, but they are led into this miſtake, from its relaxing the ſolids, whereby they better perceive the pulſe. The neceſſity of opiates appears moſt conſpicuous, in ſharp cholic pains, want of ſleep, convulſive tremors, &c.

Thus far we have purſued the curative indications that ſerve to clear the firſt paſſages

paſſages, and give immediate relief by palliating the diſeaſe; and, we have alſo laid down ſome practical obſervations and neceſſary preliminaries; which, if duly attended to, will give the phyſician the ſatisfaction of ſeeing his after preſcriptions anſwer his expectations; and the patient will likewiſe find himſelf comforted, and in ſome degree reſtored to his former health. When a phyſician, therefore, has gone through ſo much of his work, he ſhould then ſtop, look about him, firſt to the right hand, and then to the left; and carefully obſerve all the ſymptoms; the degrees of the diſeaſe, and the advances it has made; if he finds it only beginning, his taſk will be attended with leſs difficulty.

The indications of cure, will be different, in different habits, according to the cauſes that brought on the diſeaſe, the part of the body where it is ſeated, and the advances it has made.

The general cauſes of all nervous diſeaſes, are a natural delicacy and too great a ſenſibility of the nerves; a natural, or acquired

laxity

laxity of the ſolids in general, and of the ſtomach in particular; obſtructions and obſtructed perſpiration; or morbid humours, lodged in the habit, through the laxity of the fibres and languidneſs of the ſecretory veſſels.

Theſe being the cauſes, from which all nervous diſeaſes ariſe; we are neceſſarily led to three indications of cure, which may be properly enough blended and mixed together.

1ſt. The firſt intention is to reſtore the tone and elaſtitcity of the ſolids, and to corroborate and ſtrengthen the whole ſyſtem; for as nature is very much ſunk, ſhe muſt be aſſiſted, in bringing the ſeveral organs to their regular ſtandard of action; and as the ſtomach is the firſt bowel, that ſuffers, and by its ſuffering, gives riſe to moſt of the ſucceeding ſymptoms; ſo, great care muſt always be paid to it, to reſtore it to its due tone: we muſt alſo ſuſpend and leſſen, for a time, the too great ſenſibility of the nerves. And

2dly.

2dly. We muſt reſolve the obſtructions, and give vent to the putrid and ſtagnant juices; and thereby make the circulation full and free, the perſpiration current, and the ſecretions in their proper proportions. If theſe two intentions have been ſufficiently and ſucceſsfully purſued, there will remain little occaſion for the laſt, which is,

3dly. To ſcour and cleanſe the internal ſides of the veſſels of all putrid, morbid matter; to ſheath, blunt, and deſtroy all ſharpneſs and acrimony, lodged in the habit; to make the juices ſoft, ſweet and balſamic; and to reſtore the blood to its due thinneſs and fluidity.

Among the chief remedies, to anſwer the firſt intention of cure, are thoſe of the ſtrengthening and aſtringent kind; which contract, corrugate and give a firmneſs to the weak and relaxed ſolids, fibres and nerves. Of this tribe, are all *bitters*, *aromatics*, *chalybeates*, *ſubacids*, *cold bath*, &c. As *cort. peruvian.*, *chalybs*, *rad. gentianæ*, *ſummitates centaurij minoris*, *cortex aurantiorum*, *zedoaria*,

zedoaria, cinnamom, cortex winterian., flores chamæmeli, ſummitates abſinthij, elixir vitriol acidum. Waters of Bath, Spa, Pyrmont, Tunbridge, Llandryndod, &c.

BITTERS may be exhibited in vinous or aquious infuſions; or brandy may be uſed as a menſtruum: the doſe muſt be adapted to the conſtitution of the patient; and if it proves too heating, it may be weakened with ſome drops of the *elixir* of *vitriol*, or *juice* of *lemons*.

There is not a more wonderful ſtrengthener of the ſolids, in all the materia medica, than the BARK; nothing more promotes gouty humours towards the extremities; it ſtrengthens the ſolids; and will itſelf often give a fit, when nothing elſe can; if the pediluvium is uſed, and warm things are applied to the feet, the bark rarely fails to bring a fit; and after a ſevere fit, there is nothing more effectual to recover the appetite, and ſtrengthen the ſpirits. It may be given in ſubſtance, decoction, or infuſion. In ſubſtance it often diſagrees with delicate conſtitutions, occaſioning

fioning gripes, purging and ſickneſs; but an infuſion or decoction of it, in water, with a cordial aromatic, does not ſo often diſagree; and if infuſed in brandy, it agrees with moſt conſtitutions. Dr. Whytt, recommends a glaſs of red wine to be taken after each doſe of it, and ſays, that the gripes and purging, may be prevented, by adding *confectio japonica* to it for a few days.

Although the bark is preferable, as a ſtrengthener, to any of the bitters, yet it does not wholly ſupercede their uſe; they agree very well, when joined together; as

℞ Cort. peruvian. ℥ ſs. flor. chamœmel. m. 1, cocci-nel. ʒſs. coque. in aqu. font. ℔ 1ſs. ad. ℥ 12ſs cola; cui adde vin. chalyb. ℥ 2ſs. ſpt. lavend. c. ʒ6 cujus cap. ℥ 2ſs.

vel

℞ Conſerv. fol. rutæ. conſerv. fol. roris. marin. āā ℥ 1 cort. peruvian. ʒ6. cort. winter. ʒ3. ſyr. caryphyl. rub. q. s. ut f. elect. cap. q. n. jugland. 6ta quaque hora.

vel

℞ Cort. peruvian. pulv. ℥ 4 rad. gentian. cort. aurant. āā ℥ 1ſs. miſce, infunde in ſpir. vin. gall. ℔4 in B. A. per dies 6 cola. D. cochl. 1. in aqu. commun. cochl. 4

vel 5. cum. elix. vitriol. gut. 20 vel 30, ſi tibi. placeat, hora anta jentaculum & hora 6ta veſper.

Dr. Whytt ſays, that an ounce or more of *ſpt. lavind. comp.* added to each pound of this tincture, improves its taſtes, and makes it ſit better on the ſtomach.

Next to the bark is STEEL, all its preparations; and chalybeate waters. There are few medecines that ſo remarkably ſtrengthen the ſtomach, bowels, and whole habit as iron doth. With weak and young perſons, and in ſlight caſes, liquid ſteel does well; as vin. chalyb, tinct. martis in ſp. ſalis, ſal. martis.

Thoſe who are ſtronger and older, require ſteel ruſt joined with *aromatics*, *bitters* and the *bark*; where theſe do not relieve, the caſe is either very bad, or the patient has not been properly prepared. But in adminiſtring chalybeates, we ſhould be careful not to force nature to over-act its part; ſometimes the ſtagnant juices are thrown upon the thighs and legs; in which caſe they ſwell very much; when that happens,

you

you ought to give a gentle purge or vomit; but the laſt is not raſhly to be adminiſtered, leſt we bring the humours again into the habit. Let the legs and thighs be kept warm with flannel, wetting them now and then with camphorated ſpirit of wine, &c. then let the patient drink chalybeate waters; and if much reduced, and of a bilious conſtitution, he ought to drink aſſes milk, with teſtaceous powders, for a month, then Bath waters. If the conſtitution is highly ſcorbutic, Tunbridge, Iſlington, Hampſtead, or Llandryndod waters are the beſt.

The medicines I ſucceſsfully uſed in the firſt intention, were,

℞ Tinct. mart. ʒ1 in aquæ cyatho ſumend.

vel

℞ Vin chalybeat. cochl. 1. ter in die.

vel

℞ Sal. mart. extract. cort. peruvian. āā p. 8. f. pil. D. gr. 10. ter quaterve in die.

vel

℞ Sal. mart. ʒ2 N. M. Zingib. āā ʒ4 ol. cinnamom. qnt. 5 conſerv. flav. cort. aurant. ℥ 1 ſyr. balſam. q. s. ut f. elect. D. q. n. m.

vel

vel

℞ Chalyb cum ſulphr. p. 32 N. M. conſerv. abſinth. rom. āā ʒ 1 Z. Z. 31 ol. cinnamom. qnt. 12 ſyr. e ſpin. cerv. q. ſ. f. elect. D. q. m. n. ter in die.

vel

℞ Extract. cort. peruvian. gr. 12 ſal. mart. gr. 8 ol. cinnamom. qnt. 1 ſacchar. ℈ſs m.

vel

℞ Spec. aromatic. extract. gentian. āā ℈1ſs. extr. cort. peruv. gr. 15. ſal. mart. ℈ſs. bals. peruvian. q. s. ut f. pil. 31=10 D. 2. ter in die.

The *elixir* of *vitriol*, taken twice a day in ſpring water, excellently ſtrengthens the ſtomach, and reſtores a decayed appetite.

℞ Elix. vitriol. acid. qnt. 30 in aquæ cyatho.

vel

℞ Spt. vitriol. ten. qnt. 20 in aq. cyatho.

vel

℞ Elix. vitriol. qnt. 12. ter in die in hauſt. vin. alb. mont.

But a long courſe of chalybeate waters, is the moſt effectual of any; as Spa, Pyrmont,

mont, Tunbridge, or Llandryndod, in hot weather; and Bath, in temperate and cold weather. If the ſtomach is foul, theſe waters will occaſion head-achs, ſickneſs, giddineſs, miſts, or dimneſs before the eyes; therefore we ſhould cleanſe the *primæ viæ*, before we enter upon a courſe of chalybeate water: When the *primæ viæ* are pretty clear, then we may join *volatiles*, *aromatics*, and bitters with the waters.

But of all things that I have ever yet made uſe of, the cold bath is the greateſt ſtrengthener of the nerves; it removes glandular obſtructions; raiſes the ſpirits; and vivifies and ſtrengthens the whole man; for children, delicate conſtitutions, and women liable to miſcarriages, or troubleſome floodings, nothing can be better. Much might be ſaid in praiſe of cold bathing, but as I have largely inſiſted upon its virtues in my *New Syſtem* of *Phyſic*, I ſhall here only obſerve, that where the ſtomach, liver, or other viſcera are unſound, the cold bath is improper.

The

The ſecond part of the firſt intention of cure, viz. to render the nerves leſs ſenſible of irritation, and thereby leſſen the ſenſe of pain, to ſtop tremors, convulſions, ſpaſms, &c. is done by means of *opium*, *camphor*, *muſk*, *hellebor*, and the *fætid gums*.

The virtues of *opium* I have already mentioned. The nature and virtue of camphor, muſk, &c. are fully taken notice of in my *New Syſtem* of *Phyſic*, to which I refer the reader; ſhall here only obſerve, that *camphor* is an excellent antiſpaſmodic and antiſeptic; opens obſtructions; wonderfully promotes perſpiration; procures ſleep and quiets deliriums, and has ſo extraordinary virtues in all nervous caſes, that, after the preparatory courſe is ended, I always give camphor along with the bark; or the camphorated julep by itſelf, to which I ſometimes add *vin. antimon.* every night, after the pediluvium; by which means perſpiration is kept up, and the morbid matter is thrown out of the habit by the ſkin; an outlet which nature chuſes moſt to make uſe of; *camphor*, and *antimony*, are the two

beſt

beſt medicines in the Materia Medica for promoting a diaphoreſis; and indeed to anſwer any intention, nothing ever came, or ever will come up to antimony; which will, in the hands of a ſkilful phyſician, do wonders. Next to theſe I have found the beſt effects from MUSK, which may be given where opium is improper, and caſtor too hot; it ſeldom or ever diſagrees, if given in ſufficiently large doſes: it is chiefly uſeful in the ſubſultus tendinum in fevers, furor uteri, ſpaſms, hiccup, cramp in the ſtomach, chin-cough, and ſpaſmodic aſthma. I have tried caſtor ſeveral times, but never experienced any good effects from it.

Aſafœtida is the ſtrongeſt of all the fœtid gums; it quiets anxiety and oppreſſion; procures reſt, and all the other benefits of opium, with none of its bad effects; it pervades the whole habit; penetrates the ſmalleſt veſſels; promotes perſpiration; and, when other proper medicines are joined with it, will help to forward a laſting cure: joined with volatile ſalts, it procures reſt; at-

tenuates viſcid juices; and is good in flatulencies, ſpaſms, &c.

But it is to be remarked, that opium and the fœtid gums are not deſigned to bring about a radical cure: they are only to be looked upon as palliatives for leſſening or removing the preſent pain.

The forms that I commonly uſed as palliatives, were,

℞ Camphor. gr.12 extract. thebaic. gr.1 ſyr. e. cort. aurant. q. s. f. bolus.

vel

℞ Maſch. gr.12 ſal. vol. c. c. gr. 10 rad. ſerpentariæ gr.15 conf. alkermes. q. s. ut f. bolus.

vel

℞ Pil. ſapon. gr.8. mithridat. q. s. ut f. bolus.

vel

℞ Antimon. diaphor. ʒ1 croci. camphor. ſal. ſuccinc. āā gr.10 elect. e ſcordio q. s. ut f. pil. D. No 4 hora ſom.

vel

℞ Aq. alexeter. ℥4 ſpt. mendereri ſs. ſal. c. c. gr.3 ſacchar. alb. ʒ3

vel

vel

℞ Aq. alexeter. ſimp. ℥ iſs.—ſpt. 33 ſyr. caryophyl. rub. 32 M.

vel

℞ Aſæfœtid. ℈ 2 ol. aniſi qnt. 30 f. pilulæ doſes ℈ i.

vel

℞ Moſch. ℈2 gum arab. ℈ i ſimul trit, adde aqu. roſar. ℥ 5 ſyr. e. meconio ℥ i f. julep. doſ. ℥ i

vel

℞ Valerian. ſylv. rad. pulv. ℈ i aq. cinnamom. ſimp. ℥ i M.

vel

℞ Jul. e camphor. ℥ i vin. antimon. gut. 30 aq. alex. ſimp. ℥ iſs. M.

We now come to the ſecond intention of cure, viz. to open the obſtructions, and give vent to the putrid and ſtagnant juices; whereby the circulation becomes full and free; the perſpiration current; and the ſecretions in their proper proportions.

But as I mentioned before, this intention may be purſued in conjunction with the other.

To anſwer our ſecond intention, we are to make choice of thoſe medicines, which are found to have theſe virtues, ariſing either from their activity, figure of parts, or force and momentum: nor are we to neglect, what experience ſhews us to be good, though we are at a loſs to know by what means they operate; we ought to ſteer the middle courſe between credulity and infidelity.

Among the chief and principal medicines are *antimony, mercury, camphor. hellebore. arum. valerian, cicuta, ſoap, lime water, the woods, acids, all fixed ſalts, all antiſcorbutic plants, gum. ammon. galbanum aſafœtida, myrrh, all aromtaics and volatile ſalts*, are diobſtruents in nervous caſes: alſo *ſquills contrayerva, ſulphur*, the *accidulæ, ſpirit of ſcurvy graſs, ſpirit mendereri*, &c.

Of all diobſtruents, ANTIMONY is the beſt, the uſe of which alone will elegantly, ſafely and effectually anſwer the ſecond intention of cure, in nervous diſeaſes; I ſeldom ſuffer the patient to go to bed one night

night without half a grain, or a grain of emetic tartar or camphor; when the bile is obſtructed and offends, I give the infuſion of ſena, with gr. 1 of emetic tartar. When antimony is properly doſed, it occaſions no tumults in the body; but paſſes eaſily and readily into the blood. Its efficacy in childrens epileptic and convulſive fits is ſufficiently known.

MERCURY is not a proper medicine in nervous caſes, and ſhould never be exhibited alone, without ſome ſtimulating medicine joined with it: for it is indolent in itſelf, acts only by its gravity, and has no ſtimulating quality, as ſome have imagined. As the circulation is languid, and the ſolids lax, in all nervous caſes; ſo the blood has not ſufficient velocity to carry it through the ſmall capillary veſſels; but it often ſtops there, and forms new obſtructions: and, by its ſceptic quality, corrupts the juices, relaxes the ſolids; and will often produce nervous ſymptoms, where they were not before. Therefore, whoever is ſo great a friend to its uſe, as not to be inclined to neglect

neglect preſcribing it, in nervous caſes, ought to give it in ſmall quantities, with ſome ſtimulating medicine. *Mercurius dulcis* is the beſt, ſafeſt, and moſt certain preparation of it we have, and will anſwer all the intentions, that mercury is capable of performing, except that of an emetic; in which caſe ſomething elſe ſhould be uſed. It often paſſes through the bowels, before it enters the habit; and at other times raiſes a ſcorbutic ptyaliſm; which ſinks, and does irrepairable miſchief to the patient.

To prevent theſe bad effects of mercury, in the firſt caſe, it ſhould be joined with ſome warm aſtringent medicine, as *mithridatum, elect. e ſcordio, cort. peruv.* In the ſecond caſe, it ſhould be given in ſmaller doſes, with ſome preparation of antimony, as *ſulphur. antimon. præcipitat.* Though I think the ſafeſt and beſt practice is, not to uſe it at all in nervous caſes.

VALERIAN is the moſt active and volatile of all the vegitables, and ſeems to act chiefly by promoting perſpiration, and a gentle diaphoreſis, which is abſolutely neceſſary

ceſſary in the cure of nervous diſeaſes. The root powdered with cinnabar of antimony, and black hellebore, has admirable ſucceſs. It is an excellent diluter when drunk as tea; joined with camphor, it opens the minuteſt obſtructions, and cures agues; its unpleaſant flavour is concealed by the addition of mace.

There are too ſorts of *hellebore*; the *black* and *white*. They are both medicines of wonderful efficacy. The *black* is the mildeſt, and if uſed with judgment, is a wonderful alterative and ſudorific, for attenuating viſcid humours, and removing invetrate obſtructions of the glands, &c. The *white* is poſſeſſed of equal, if not ſuperior virtues; but is much ſtronger; therefore the doſe muſt be proportionably ſmaller. I have likewiſe found conſiderable benefit from the *compound powder* of *arum*. in ſluggiſh temperaments, where viſcid phlegm and crude juices abound in the *primæ viæ*; it opens obſtructions, both of the viſcera and remoter glands, and is of ſervice in exciting appetite.

The

The CICUTA is a valuable medicine, both internally and externally in all ſcrophulous tumours, indurated glands, and in ſcirrhous and œdematous ſwelling, in any part of the body. I ſeldom give it by itſelf, but join to it the bark, and ſome volatile aromatic ſimple, or camphor: and every ſecond or third day, it is proper to preſcribe a gentle cathartic, or a few grains of antimony, ſo as to give a puke, and two or three ſtools: I generally preſcribe the ſulphur of antimony, or emetic tartar. With this method of treatment, I have overcome moſt inveterate chronical diſeaſes.

SOAP, triturated with reſinous matters, is an excellent diobſtruent medicine, for attenuating viſcid juices, opening glandular obſtructions, and ſcouring and deterging all the viſcera; it has the advantage over mercury, and all ſtimulating acrid diſobſtruents, in this, that it may be uſed in moſt caſes, without irritating and inflaming, and conſequently without any hazard of changing a ſchirrous ſwelling into a cancerous one: it diſſolves the human calculus. The uſe of ſoap ſhould be accompanied with the bark or bitters and ſome cordial ſtomachic water, with a few

a few grains of camphor; and as ſoap ſeems to remove obſtructions by melting down the morbid indurated matter, and thereby fitting it to be reabſorbed into the maſs; therefore, after the uſe of ſoap for ſome time, the offending matter ſhould be evacuated by diaphoretics and gentle emetics, repeated at proper intervals. Soap given in too large quantities, or too long continued, is hurtful to every conſtitution; but eſpecially to the nervous and ſcorbutic patient: and not a few, I believe, have hurt their conſtitutions with Mrs. *Steven's* medicine.

LIME WATER and a DECOCTION of the WOODS are excellent medicines; they may be very properly joined together. Lime water is an admirable ſtomachic; is very effectual in killing worms lodged there; is antiſeptic, and corrects immoderate acidities and concretions, the cauſe of many chronical diſeaſes; it prevents the production of phlegm in the ſtomach, after taking a gentle vomit of ſquills; is of great ſervice in the gout and rheumatiſm, and greatly mends the appetite; does good in every morbid ſtate, and foulneſs

of the blood; and is particularly uſeful in all cold, corpulent and phlegmatic habits. It may be taken thrice a day, either alone, with milk, or with the decoction of the woods, which promotes its virtues. I have found very good effects from *decoct. lignorum* with *ſpt. cochleariæ* or *ſpt. mendereri.*

SQUILLS powerfully ſtimulate the ſolids, attenuate viſcid juices, promote expectoration, urine and ſweat; and are a uſeful alterative. Certain acrid ſubſtances have been recommended, in dry, nervous and convulſive aſthmas; and ſquills in particular; but it ſeems probable, that the aſthma is not cured, but the particular effects of it are removed by the medicine.

In all aſthmas, the free circulation of the blood through the pulmonary veſſels, is impeded; and hence, during every paroxyſm, the lungs are in a kind of œdematous ſtate: if this œdema remains after the fit is over, and becomes habitual; it is either perpetually occaſioning freſh ones; or gives riſe to a dropſy of the breaſt.

Acrid

Acrid medicines, by removing the œdema, remove what is originally the effect of the aſthma; and in time the cauſe of its aggravation. For acrids, eſpecially ſquills, are powerful expectorants and diobſtruents; they ſtimulate the veſſels; and diſſolve tenacious juices: therefore are eminently ſerviceable in cold, leucophlegmatic habits, in ſtagnations of the fluids, and where the contractile power of the ſolids are weak: but in hot, bilious conſtitutions, or plethoric habits, and in inflamatory diſtempers, where there is already a degree of irritation, and where the juices are too thin and acrimonious, or the viſcera unſound; theſe ſtimulating medicines, as ſquills, garlic, &c. prove highly prejudicial, and never fail to aggravate the diſeaſe.

In the true ſpaſmodic aſthma, ariſing from too great a delicacy, and irritability of the lungs; when there is no fixed obſtruction in the lungs, nor any load of phlegm oppreſſing them; the fits are beſt relieved by large bleeding, if the habit is ſanguine

and full; if the habit is thin, then opium is of great ſervice, as, elixir paregoricum.

vel.

℞ Syr. è. meconio ℥ 1 aqu. menth. vulg. ℥ 1ſs. f. hauſtus.

vel.

℞ Tinct. thebaic. qnt. 15 aq. cinnamon. ſimpl. ℥ 1 ſyr. e. mecon. ℥ 1 f. hauſtus.

vel.

℞ Aq. menth.—fænic. āā ℥ 2 ſyr. caryophyl. ℥ 1 laudan. liquid. qn. 20 m. D. cochl. l. ſingulis ſemehoris.

vel.

℞ Aqu. menth. ℥ 1ſs. laud. liquid. ſp. volat. oleos. ā qnt. 25 ſyr. commun. ℥ 1 m.

vel.

℞ Caſtor. ℈ 1 ſal. c. c. gr. 5. tinct. thebaic. qnt. 20 ſacharo inſtillat. m.

Any of the above medicines leſſens or removes the difficulty of breathing, faintneſs, and frequent ſighing, with which, women after child bearing, are ſometimes afflicted. Alſo *aſaſætida, tincture* of *caſtor*, and *ſpirit* of *hartſhorn* are often uſeful.

When the lungs are obſtructed, or greatly loaded with phlegm, we ought not to give opiates;

opiates; till the tough, viſcid matter is diſcharged by vomits, and even then they ought to be ſparingly uſed. But bleeding is of ſervice, in all caſes, where there is a *plethora* or heat, except where the ſuppuration is begun. After bleeding, the medicines are more eaſily and properly conveyed into the blood, and have more freedom to act.

Some have recommended *pil. mercur. lax.* or *liquid quick-ſilver*, with a thin diet, as a ſovereign remedy for diſſolving the phlegm; aſſiſting expectoration, and rendering expiration and inſpiration eaſy; as I have never made trial of theſe medicines, can ſay nothing of them: but have found great effects from a large bliſter between the ſhoulders, and ſometimes a perpetual bliſter. A gentle purge of *glauber ſalts*, *manna*, *tartar ſolub.* &c. leſſens or carries off the fit; after which, gentle emetics are of great uſe; and draughts of *lac. ammon.* or *gum. ammoniac*, *ſal. abſinth.* and *aſſafætida* do wonders, if the bowels are not lax; but if the bowels are weak, then apply bliſters to the ancles, and one between the ſhoulders; bathe the feet;

feet; give ſmall doſes of vinegar of ſquills or ſyr. of ſquills with ſalt of vipers, and balſ. of tolu; and ſtrengthen the bowels with bitters given in ſome cordial water; or joined with ſmall doſes of the bark to camphor: this method will cure an aſthma, even though the matter is gouty. If the lungs are much obſtructed and loaded with with phlegm; then we are to be cautious in uſing the bark, and call in the aſſiſtance of iſſues, ſetons, &c.

MYRRH, is an excellent medicine in aſthmatic caſes; it warms and ſtrengthens the viſcera; diſſolves thick, tenacious juices; promotes a diaphoreſis, and all the fluid ſecretions; is of great uſe in all languid caſes, and in all diſeaſes ariſing from a cold, mucous, ſluggiſh indiſpoſition of the humours, and where the thorax and lungs are oppreſſed with viſcid phlegm.

Cherry, Rheniſh wine, ſmall French wine, or toaſt and water, are the beſt drink in aſthmas; and a large piece of flannel, wore on the breaſt, does good. The fits

are

are beſt prevented from returning, by means of the bark, chalybeates, bitters; as *tinct. rhabarb. amara, elix. ſacrum.* or *two or three grains of aloes, an hour before dinner*; alſo *acids*, as *elix. vitriol. country air, gentle exerciſe, &c.* give the patient great relief. For though, by repeated vomits, we clear the lungs and ſtomach of phlegm; yet, if we do not ſtrengthen the ſolids and ſecretory veſſels, more phlegm will be continually produced: wherefore, after evacuating the phlegm, we muſt have recourſe to the bark, &c. I have tried what Dr. Whytt recommends, viz. to take an infuſion of horſe-radiſh, a little brandy, or powder of muſtard with each draught of water, when a vomit of ipecacoana is taken; but in that caſe it produced a ſlight inflammation in the ſtomach.

When the aſthma is owing to indolent obſtructions; which have their ſeat in the ſecretory tubes of the glands; or in the glandular follicles or cellular membrane; then we muſt endeavour to reſolve them by degrees, and in the mean time palliate the moſt troubleſome ſymptoms. Complaints of want of appetite, indigeſtion, vomiting, flatulence,

flatulence, ſickneſs, pains in the belly, which are obſtinate and will not yield to medicines, but become worſe, generally ariſe from ſome fixed obſtruction; the beſt way to reſolve obſtinate obſtructions, is by friction, baths, ſteams of hot vinegar, fomentation, with opodeldoch, camphorated ſpirit of wine, decoction of wormwood tops, camomæle flowers, hemlock tops, ſpirit of wine and vinegar; by plaiſters of mercury, or of the cicuta with gum ammoniac; by gentle vomits and purges frequently repeated; by ripe fruit; by the uſe of the diobſtruent medicines already mentioned; and eſpecially by the external and internal uſe of the *cicuta*; the *pil. mercurial. laxant. ſulph. antimon. præcipetat. tartar. ſolubilis. ſal. polychriſt.* &c. &c. are good medicines.

If the patient be of a full habit; and if there appears no indication for the contrary, we ought always to begin with bleeding.

Large diſcharges of LIMPID URINE, are prevented, by promoting a full and free perſpiration; by warm cordials and diaphoretics;

tics; by a ſtrengthening plaiſter applied to the loin; and by the bark, bitters, &c. &c.

LOWNESS and DISPIRITEDNESS, without pain or ſickneſs, ariſe from the ſame cauſe, and may be cured by volatile ſpirits, aromatics, cordials, diaphoretics, and whatever ſtimulates the ſolids, to forward a briſk circulation and perſpiration. The beſt medicines, in this caſe, are chalybeates, the bark, Bath water in temperate and cold weather, and Spaw, Pyrmont, and Tunbridge, in hot weather. If none of theſe can be had; then uſe chalyb. rub. præp. ſpec. aromatic. &c. and waſh them down with an agreeable bitter, appropriated to the patient's conſtitution and ſtrength, as elix. vitriol. acid., elix. vitriol. dul., tinct. martis., elix. proprietates, &c. in ſome cordial or common water. When low ſpirits are owing to a weak ſtate of the nerves of the ſtomach and bowels; then we muſt add to the foregoing medicines, gentle exerciſe. When they ariſe from hypochondriac obſtructions, or foulneſs of the primæ viæ; then uſe ſtomach

purges, as aloes, pil. ſtomachicæ, Harragate water, tartar ſolub.

SPITTING and SALIVATION, are cured by a gentle vomit, or a ſtomach purge of rhubarb and aloes, or pilulæ ſtomachicæ; then give aſtringent bitters, as infuſion of the bark with aromatics, or chalybeates with aromatics.

In FLATULENCIES we are to procure ſpeedy relief, by expelling the wind, and then ſtrengthening the viſcera. The firſt intention is anſwered by carmiantives, opium, tincture of caſtor, pepper-mint-water, ſpt. nitri dulcis, aſafætida; and by the medicines moſt proper for ſtrengthening the ſtomach, already mentioned; applying, at the ſame time, a ſtrengthening plaiſter to the ſtomach. If the windy complaints are attended with coſtiveneſs, then Dr. W. recommends the following,

℞ As. fœtid. ʒ 2 aloes. ſocotrin. ſal. mart. rad. zingib, āā ʒ 1 elix. proprietat. q. s. ut. f. pil. gr. 4

When the body is too open, then you may give

℞ Rhabarbar.

℞ Rabarbar. gr. lo confect. japonic. ℈ ıſs m. ut. f. bolus

Or *gentle vomits, ſmall doſes of ipecacoanha, carminatives,* &c.

An hyſteric cholic, ariſing from gouty matter, ſometimes ends in a lameneſs of the feet or hands; which is cured by vomits; by the bark and bitters before dinner; and by the bark with rhubarb at night; rubbing the hands and feet with opodeldoch, or camphorated ſpirits: and an habitual diarrhæa is cured by the ſame medicines, and toaſted rhubarb, teſtacious powders, and diacodium.

BILIOUS and PORACIOUS VOMITING, is cured by a gentle antimonial emetic; by an infuſion of ſena, with emetic tartar; or by bark and rhubarb, with other bitters and cordials, chalybeate waters, volatiles and fœtids, and a regulation of diet.

PERIODICAL HEAD-ACHS, are cured by emetics, when the ſtomach is loaded; and by the pil. gummos. cum aloe, and a draught of ſack whey or water gruel, with ſpt. c. c. vol. every night, till well; and afterwards re-

peating them about the paroxyſms. If there is any acid in the ſtomach, the teſtacious powders, magneſia alba, and lime water, will be found uſeful. In head-achs proceeding from a rheumatic or gouty humour; and likewiſe in all violent or fixed pains, in any part of the body, ariſing from the ſame cauſe, bliſters applied to the part affected, iſſues, friction and pediluvium, are the proper remedies. Their violence may be leſſened by fomenting the part with camphorated ſpt. of wine, compound ſpt. of lavender and opium; and by the internal uſe of opium, camphor, muſk and valerian. Dr. W. ſays, the following draught leſſens the pain, and ſeldom fails to raiſe a plentiful ſweat:

℞ Laud. liquid. gut. 40 tinct. ipecacoan. qnt. 45 ſpt. mendereri. ℥ſs. aq. roſar. ℥i ſacchar. alb. ʒ2 M.

If it is occaſioned by a ſuppreſſion of the menſes, then bleeding, and other proper methods are to be uſed to obtain a return.

The application of leeches to the temples, and cold water falling from a conſiderable

derable height upon the head, are of great ſervice.

To anſwer the ſecond intention of cure, we may uſe one or more of the following forms:

℞ Rad. hellebor. nig. gr.8 pulv. ari. c. gr.5 ſal. ſuccin. croci ā gr.6 m.; in vin. alb. vel in aq. pulegij cyatho ſumend.

vel

℞ Tartar. emetic. gr.2 magn. alb. ʒſs contere diu in mort. marm. ut f. pulv. ſubteliſs. D. gr.5 ad 12

vel

℞ Rad. valerian. ℈1 caſtor. croci āā gr.5 as.fœtid. gr.4 m. ut f. pulv.

vel

℞ Gum. ammon. ſapon. dur. ā ʒ1 ſcill. pulver. ℈1 conſerv. flav. cort. aurant. ʒ4 ſyr. Z. Z. q. s. ut f. elect.

vel

℞ Antimon. illot. ʒ3 optime lævigat. cum reſin. guaiac. ʒ2 ol. e rad. ſaſſaf. gut.6 conſerv. roſ. rub. ʒ2 ſyr. balſam. q. s. ut f. elect. ſuperbib. Aq. calcis hauſt.

vel

℞ Extract. guaiac. gr.6 ſal. c. c. gr.4 ſyr. ſimp. q. s. ut f. bolus.

vel

vel

℞ Resin. guaiac. gr.4 mercur. dul. gr.2 ol. terebinth. gut.1 confec cardiac. q. s. f. bol.

vel

℞ Pulv. ipecacoan. gr.4 spec. aromatic. gr.13 syr. e cor. aur. q. s. f. bol.

vel

℞ Sulph. aurat. antimon. mercur. dulc. subl. āā 32 quam optime lævigentur supra marmor. gum ammon.34 bals. peruv. q. s. ut f. pil. d. gr.8

vel

℞ Scill. rec. gum. ammon. sapon. dur. āā p. æ. f. pil. dos. ℈1

vel

℞ Extract. cicut. ʒ1 pulv. folior. cicutæ q. s. ut f. pil. D. gr.2 ad 31

vel

℞ Æthiop. mineral. 32 ceruss. antimon. 31 gum. guaiac. ℈1ss extract. gentian. q. s. ut f. pil. 31=10 quarum dos. 3 superbib. decoct. lignorum D. ʒ6

vel

℞ Pil. aromatic. gum. guaiac. sal. martis sal. absinth. extract. gentian. āā 31 gum. ammon. in aceto scill. solut. q. s. ut f. pil. 31=10 D. 5

vel

vel

℞ Argent. viv. extract. guaiac. dur. āā ʒ1ſs. ol. e cort. ſaſſaf. gut. 20 terebinth. ven. q. s. ut f. pil. 40 D. 2 vel 3 ſuperbib. aq. calcis, decoct. lig. p. æ.

vel

℞ Mercur. dulc. gr. 10 antimon. illot. ʒ 1 extract. guaiac. gr. 12 balſ. peruv. q. s. ut f. pil. N. 12 doſ. 1 ad 3 ſuperbib. aq. calcis cum decoct. lig.

vel

℞ Tartar. emetic mercur. dulc. āā gr. 10 aloës gr. 15 extract. thebaic. gr. 5 balſ. peruv. q. s. ut f. pil. N. 15 doſ. 1 ad. 2.

vel

℞ Mercur. dulc. gr. 10 camphor. ϑ1ſs. extract. guaiac. ϑ1 terbinth. venet. q. s. f. pil. N° 20 doſ. 1 ad 6

vel

℞ Vin. antimon. gut. 40 aq. alexiter. ʒ2 f. hauſt.

vel

℞ Gum. ammon. (in acet ſcillet. ſol.) ʒ 2 oxym. ſimp. ʒ1 aq. menth. vulg. ſimpl. ʒ6 f. mixtura dos. cochl. 2 & ſal. ammon. ʒ 1 ſeri lactis ℔2 pro polu commun.

vel

℞ Succ. cochleariæ ſuc. glycyrrhizæ āā ʒ2 ſal. tartar. ʒ 2 vin. canar. ℔2 M. D. ʒ3

The

The outward applications are,

Fotus communis, pediluvium, ſpt. vin. camphor., emplaſt. mercurial., emplaſt. com. cum gum., linament. ſapon. emplas. veſicatorium.

℞ Sinap. ſem. trit. farinæ āā p. æ. aci q. s. ut f. cataplaſm. pedibus applicand.

vel

℞ Allij contus. farinæ āā p. æ. mellis q. s. ut f. cataplaſm. pro pedibus.

℞ Cicut. fol. rec. M.2 coque ex aq. font. q. s. adde gum ammon. (*in acet. ſollut.*) ℥ ſs. *ol. amygdal.* ʒ ʒ f. cataplaſm. &c.

We now come to the

3d INTENTION of cure, which is to ſcour and cleanſe the internal ſides of the veſſels, of all putrid morbid matter, to ſheath, blunt and deſtroy all acrimony, lodged in the habit; to make the juices ſoft, ſweet and balſamic; and to reſtore the blood to its due thinneſs and fluidity; but this intention is, as I before obſerved, moſtly ſuperceded by the other two; for if the two firſt intenti-

ons

ons have been ſufficiently and ſucceſsfully purſued, there remains little occaſion for the laſt; which however ſhould not be entirely neglected; and as all the three intentions may, with great propriety, and indeed ought to be carried on together; therefore to anſwer this laſt indication in particular, we ſhould give gentle emetics or cathartics, at proper diſtances, during all the time of the courſe; ſo that the morbid matter is no ſooner unſettled, and an obſtruction opened, than it is thrown out of the body, and not ſuffered to enter and circulate with the maſs of blood, ſo as to have time to act as a ſceptic upon it. If the juices are very acrid and ſharp, we ought to preſcribe ſome agglutinant and balſamic, at a time of the day, when the patient has no other medicine to take, as *decoct. pectoral., emuls. commun.*

vel

℞ Ol. amygdal. ʒ1 gum. arabic. ʒ1 ſyr. balſam. ʒſs. diu tritis ad de aq. menth. vulg. ſimpl. ʒ8 f. mixtura.

vel

℞ Spermac. (vitel. ov. ſolut.) ʒ3 aq. cinnamom. ſimpl. ʒ6 ſyr. balſam. ʒ1 f. mixtura doſ. cochl. 2.

vel

℞ Aqu. hordeat ʒ6 aqu. roſ. ʒ2 ſyr. balſam. ʒ6 m. f. julep. &c.

If the morbid matter be of the gouty or rheumatic kind, we muſt endeavour to throw it upon the extremities by the uſe of bitters, bark, ſteel, aromatics and cordials, which ſtrengthen the viſcera, whereby they are enabled to throw off the morbid matter. Iſſues and perpetual bliſters are of great uſe in gouty, and rheumatic complaints; if the pain is fixed, as in the ſciatica or chronic rheumatiſm, then apply a bliſter to the part affected; ſometimes I have applied, with great ſucceſs, three bliſters, one immediately after another, to the ſame place; vomits too are no deſpicable remedy in the gout.

When the ſpungyneſs of the gums, a laſſitude, lowneſs of ſpirits, or melancholy flatulence, frequent ſpitting, bad digeſtion, flying pains, and other ſymptoms, diſcover that the patient has a ſcorbutic taint in his blood; then we muſt endeavour to drive the

the morbid humour towards the ſkin by vomits, warm ſtomachics, bitters, bark, ſudorifics, mild alteratives, and purging mineral waters. Dr. W. recommends twelve grains of the *pilulæ æthiopicæ* every night, at bed time, and every other morning a dram, or a dram and a half of *polychriſt ſalt*, diſſolved in a pint of water; and, when the obſtinacy of the caſe requires it, he orders the pills to be given morning and night. When the raſh, or miliary eruption falls upon the internal parts, inſtead of being thrown out upon the ſkin, it generally occaſions a great depreſſion of ſpirits, anxiety and faintneſs, pale urine, watching, and ſometimes raving and convulſions; if the patient is plethoric, we muſt bleed, bathe the feet, and give camphor, ſpt. mendereri, hartſhorn, bitters, and put on bliſters.

CHAP. III.

OF A NERVOUS FEVER.

AS ſtrong, tenſe fibres, much denſe blood, abounding with acrid ſalt, will ſtimulate the heart to more frequent and vehement contractions, and produce an inflammatory fever; ſo, on the contrary, lax, fibres, great evacuations, thin and poor blood, ſtudy, fatigue, foul air, imprudent uſe of mercury, immoderate uſe of venery, unwholeſome food, rainy and foggy weather, long and great anxiety of mind, diſagreeable news or cold, will occaſion a ſmall irregular and diſturbed ſecretion of the animal æther, conſequently low ſpirits. Theſe cauſes alſo produce obſtructions in the ſerous and lymphatic veſſels; and the ſtagnant lymph grows more and more acrimonious, which brings on more or leſs of a fever, known by a quicker pulſe; and nervous ſymptoms ariſe, which denominate the fever to be nervous; for thoſe diſtempers only ought

to

to be called nervous, that are attended with a looſe and relaxed ſtate of the fibres, which are known from ſome one or more of the ſymptoms I have already mentioned: and thoſe diſeaſes are called hot or inflammatory, where the ſolids are tenſe and firm, the ſymptoms high, and the blood inflammatory. According to this diſtinction, it will be eaſy to determine the nature and conſtitution of a nervous fever.

The ſymptoms of ſuch a fever are rigor or chilline ſs, which, though not ſtrong and violent at firſt, yet is long and ſlow, and creeps on imperceptibly; the heat afterwards is not intenſe, nor the head-ach and ſickneſs great, but rather continued; the pulſe is neither ſo quick, ſtrong and full as in an inflammatory fever, but ſmall, oppreſſed and ſometimes intermitting; the ſleep reſembles a lethargic dozing, or dreaming, with ſtartings; the urine ſometimes crude, ſometimes pale, and in great quantity, without much ſediment, at firſt; in ſhort the fever rather creeps on than attacks and ſurprizes; and the whole exordium or firſt ſtage is ſo

ſlow, that it is ſix, ſeven, or perhaps nine days before it comes to its ſtate, by which any one may judge of the duration of the whole; for the ſooner a fever comes to its ſtate, the ſhorter is its duration, and danger; but in nervous fevers 'tis longer before aſſiſtance is called, means uſed, or the latent enemy diſcovered; therefore the danger is commonly very great. Before the fever comes to its ſtate, the ſlight chillings are ſucceded by ſudden fluſhes of heat, inactivity, reſtleſſneſs, dejection of ſpirits, diſlike to all food, ſlight nauſea, and reachings which bring up tough phlegm; go and come in the day, but are always worſt at night.

Theſe ſymptoms, are but ſlight, till the fever comes to its ſtate; after that the head becomes more ſtupid and confuſed, and almoſt incapable of receiving impreſſions, with a ſlight delirium, and obtuſe pain; the tongue is ſeldom dry or black, till towards the end, and ſometimes not then, but is often covered with a thick browniſh or white cruſt. The patient ſeldom complains of thirſt, or aſks for drink; but complains of an oppreſſion at his breaſt,

with

with a difficulty of breathing, and is troubled with a gulping or choaking: the countenance is pale, heavy, and ſunk, the cheeks are often fluſhed, and the tip of the noſe and ears cold and moiſt; the head becomes more heavy and giddy; the pulſe riſes, is quick and unequal, yet ſmall and thready; ſometimes it flutters; the urine now is ſometimes limpid and much; ſometimes broken and in ſmall quantity; of a whitiſh colour, as if bran had been mixed with it; but never has a full or groſs lateritious ſediment. From the 7th, 9th, or 15th, day the ſymptoms often grow worſe and new ones come on, as noiſe in the ears, a load on the præcordia, anxiety and fainting upon the leaſt motion, a delirium, which is ſeldom violent, but rather a confuſion of thought and action, ſuddenly recollecting, muttering a little, and then falling into a dozing ſtate, in a careleſs and unnatural poſture of the body; ſometimes he is in a watching, comatoſe ſtate, with ſtaring eyes, or with their whites turned outwards; and at other times he uſes ſimple and childiſh geſticulations.

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If the tongue, from being very dry, becomes moiſt about the ſtate, or cloſe of the diſeaſe; then you may expect a copious ſpitting, which is a good ſign.

If the urine grows more pale and limpid; then you may expect a delirium, with convulſive tremors and *ſubſultus tendinum*. If difficulty of ſwallowing, gulping, and choaking in the throat come on, 'tis a very dangerous ſign, eſpecially if accompanied with any degree of ſingultus. Sometimes a profuſe cold and clammy ſweat comes on; at other times thin ſtools are diſcharged, which commonly takes off the delirium, tho' they are generally colliquative and weakening. The belly, though it was at firſt open, and tending to a diarrhæa, now generally becomes conſtipated and tumified, with flatulencies. The tip of the noſe and ears have often an *ichor*; and ſometimes an impoſthume is formed in the ear.

The patient, who at firſt was very ſuſceptible of the ſmalleſt noiſe, is now quite inſenſible to the loudeſt; and the delirium turns to a coma: if this deafneſs ends in

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an impoſthume in the ears, it is a good ſymptom.

Now nature ſinks apace, the extremeties become cold, the nails pale and livid, the pulſe is ſo exceeding weak, as ſcarce to be diſcovered, it trembles, flutters, and often intermits, the ſtools, urine, and tears run off involuntarily. If the parotids ſuppurate, or if a large eruption breaks out about the lips or noſe, they are good ſigns; when tremblings and twitchings of the nerves and tendons come on, they are preludes to a general convulſion, and ſigns of a ſpeedy diſſolution; in one or all of theſe ways the patient is often carried off, after having languiſhed from the 15th to the 20th, 30th, and ſometimes to the 40th day.

Sometimes in this fever, they ſleep as it were into the arms of death, and if a criſis happens, it is into a mere languor and inſenſibility, a confirmed *cachexy* with deep nervous ſymptoms, or ſettled melancholy, a palſy, ſome mortified limb, a violent and laſting

diarrhæa; and ſometimes thoſe of the more benign kind terminate in intermittents.

That all the humours of the body grow more and more corroſive, the longer they ſtagnate, is evident from many examples; we ſee an hydropical ſwelling of the legs, tho' at firſt as cold as ice, becomes at laſt highly inflamed, and the humours at length ſo very acrid as to produce an eryſipelas, ulcers, &c. which are often obſerved at the cloſe of dropſies.

Now, ſeeing the ſeat of nervous fevers, ſeems to be in the ſerous lymphatic arteries; it is no wonder they are not eaſily affected by medicines: and accordingly this fever is longer in forming and longer in being removed, than thoſe of the inflammatory ſort.

A nervous fever ſoon partakes of the nature of a putrid one, and for the moſt part ends in it: it has infinite degrees and variety, according to the general ſtrength of the fibres, or the patient's time of life; but thoſe

I have

I have deſcribed are the moſt common and perhaps the worſt ſymptoms

THE CURE OF A NERVOUS FEVER.

From what has been ſaid it is pretty evident what will be the indications and beſt manner of treating a *nervous fever*. We muſt avoid great evacuations, eſpecially bleeding; it is neceſſary however to cleanſe the *primæ viæ* with a little rhubarb, manna, infuſion of ſena, with emetic tartar, &c. or with a gentle puke, as the ſymptoms indicate. If there is a *nauſea*, load and ſickneſs at the ſtomach, then a mild emetic is indicated, which may be repeated more than once, without danger. The fœces after the 3d or 4th day, ought to be brought away with glyſters, a gentle internal laxative, or with a very gentle antimonial puke. If the bile offends, an infuſion of ſena with emetic tartar, gr. $\frac{1}{2}$ to 1. ought to be preſcribed; then temperate cordial diaphoretic medicines, a diluting diet, and the judicious application of bliſters, which never ought to be neglected, are indicated. If the pa-

tient is very wakeful, which is often the caſe; then we are forced to give a gentle opiate, mixed up with ſome cordial and diaphoretics. Opiates ſhould, however, be uſed as ſparingly as poſſible; and of all the diaphoretics, in the materia medica, none comes up to camphor in this caſe; and indeed in moſt other caſes, where a diaphoreſis is indicated. Bliſters ought to be applied to the head, and the feet put into a bath. Barley water, thin chicken broth, jellies, ſago, panada with juice of a lemon and a little rheniſh wine, ſhould be frequently given: but above all things, a gentle diaphoreſis muſt be conſtantly kept up. If vaſt tremors, dejection of ſpirits, and ſubſultus tendinum come on, apply bliſters to the legs and arms, and give a diaphoretic with muſk, along with a ſaline draught as

℞ Sal. c. c. ℈ iſs. ſucc. lemon. ʒ3 aqu. alexet ſimpl, ʒ 2 M. peractâ effervescentia adde ſpt. lavend. c. ſyr. croci ā ʒ2 m. ut f. hauſtus doſ. repet. quinta vel ſexta quaque hora.

A weak

A weak cordial with *vin. antimonial.* may be occaſionally given.

If the anxiety about the præcordia is great, and the breathing laborious, we may look for puſtular or miliary eruptions, which ought to be forwarded with ſoft eaſy cordials.

Towards the end of the fever, there are generally colliquative ſweats or ſtools, which are very weakening; in that caſe we may add the free uſe of the bark, with rhubarb, to the above medicines: I do not mean that we ſhould delay giving the bark, till towards the end of the fever, when the colliquative ſtools come on, but that then we may be more free in the uſe of it: for after the primæ viæ are cleared, we may begin with the uſe of the bark and camphor. I believe the cold bath would be found of ſervice in this fever.

A gentle laxity of the bowels, or a plentiful ſalivation, with a gentle moiſture upon the ſkin, are favourable ſymptoms, and it is only neceſſary to keep up the patient's

ſpirits,

ſpirits, and the vis vitæ with cordial and generous food.

Bliſters ſhould be early applied, and ought to be as extenſive and univerſal as poſſible, though not too ſtrong, nor applied all at once, but gradually.

If there are any indications for bleeding, we may venture upon it for once, yet it is not to be repeated, though the blood be never ſo ſizy and rheumatic, becauſe the veſſels muſt be kept full, though not turgid, in order to keep up their tenſion in order to concoct the morbid matter. We muſt endeavour by all means, to open the obſtructions, and to rouſe the weak and languiſhing ſolids, into more frequent and hearty contractions, in order to bring the fluids into a briſker circulation.

As ſoon as the patient is able, he ſhould uſe the cold bath, chalybeate waters, and gentle exerciſe.

CHAP.

CHAP. IV.

OF CONVULSIONS, SPASMS, NERVOUS AND HYSTERIC FITS.

CONVULSIVE motions, ſpaſms, hyſteric fits and paroxyſms ariſe immediately from ſomething, that irritates the brain or nerves, or affects them with a diſagreeable ſenſation.

This peccant, offending matter, may proceed from the blood, phlegm, acrid humours, obſtruction of the menſes, worms, wind, a plethora, anger, fear, acrid and putrid bile, myaſma, obſtructed perſpiration, polypus, preternatural excreſcence, ſome great bowel much obſtructed, weakened, and perhaps ſpoiled, &c.

When convulſive motions attend the nervous ſyſtem in women, they are called *hyſteric*, or *nervous fits*; and in men, *epilepſy*. And as all nervous women are not ſeized with

with hyſteric fits; neither do all ſplenetic and hypocondriacal men fall into epilepſies.

Nervous fits and paroxyſms, ariſe from acrid matter applied to the nerves, which twitches, ſtimulates, wounds and puts them under the mechanical neceſſity of exerting thoſe violent throws, cramps, contractions and ſpaſms, and thoſe other ſtruggles and efforts, to reſolve and diſengage themſelves of the offending matter; and to reſtore themſelves to their natural contractile powers.

For it is well known, that whatever pricks, ſtimulates, wounds or tears the ſolids, throws them into ſpaſms, convulſions, and contractions, firſt and chiefly in the part affected; but are afterwards, by means of the animal æther, and mechaniſm of the parts, communicated to all the parts of the body.

Therefore any ſharp corroding vapour or ſteam, wherever placed, will ſtimulate and vellicate the ſmall nervous fibrillæ, and occaſion

casion convulsions, spasms, gripes or pains, first and chiefly in the part immediately affected, and then by sympathy, or rather by a mechanical connection, in all the other parts of the body; and these convulsions continue, till the offending matter is, by such action or motion, either removed or thrown out, or till the nerves are quite fatigued, relaxed, and overpowered.

Thus choler, wind, sharp or porous juices, occasion those fits and convulsions, in the same manner, as gravel or stone, by stimulating the kidneys and urethra, raises those reachings and vomitings, which attend nephritic cases; or as the fœtus, by its motion and pressure, raises those throws and convulsions, which bring it into the world.

The various and different kinds and degrees of convulsions, arise from the quantity of offending matter, the place where it is lodged, and the more or less irritability of the nerves.

Now the fits and paroxysms of chronic diseases, exactly answer to the convulsions

in nervous and hyſteric fits. Both are exerted for the ſame reaſon, and to obtain the ſame ends; viz. to throw off the load of matter that oppreſſes the conſtitution, and to reſtore the fibres to their regular tone; which they would accompliſh, if the veſſels were all ſound, and if the fibres were not left in a ſtate of too great laxity. Immediately after the fit goes off, if the veſſels were brought and kept to their due elaſticity, the diſeaſe would certainly diſappear; for the fluids would not again run into preternatural coheſions and contacts, and form obſtructions; but when the ſolids are lax, the ſtomach, liver, ſpleen, inteſtines, womb, &c. are unable to throw off their contents; conſequently, crudities are produced in the ſtomach; the bile ſtagnates and putrifies; the monthly purgations are interrupted, &c. which bring on convulſive motions, or hyſteric fits, in order to throw off their oppreſſive load. Theſe fits obſerve regular paroxyſms; becauſe there is ſome time before the offending matter accumulates ſuch a quantity as to diſtend the coats of the veſſels, and ſtimulate the ſolids into ſo violent

contrac-

contractions. The paroxyſms differ in different people, owing to the more or leſs ſenſibility of the nerves, and nature of the obſtructed part or parts.

The paroxyſms in agues, aſthmas, &c. are the effects of nature to diſburden the conſtitution of the load of matter, that forms theſe complaints; and as the heart is the main ſpring of action, in the fits of chronic diſeaſes, ſo the brain and nerves are the chief actors in nervous fits; for the brain is to the nerves what the heart is to the blood; and as, in nervous fits, the obſtructions lie in the organs that convey ſtrength and motion; ſo there muſt be a great ſtrength and motion uſed, to remove them; and as, in the fits of agues, the obſtructions lie in the blood and groſſer fluids, ſo there is proportionably leſs ſtrength and motion needed to remove them: accordingly we ſee, that in nervous fits, the patient's body is more convulſed than in the fits of an ague: and as the blood's motion gives heat to the body, ſo there is a greater heat after the cold fit of an ague, which

we call the hot fit; than after a nervous fit.

Sometimes nervous fits are occaſioned by a polypus in the heart, or great artery, or by ſome preternatural excreſcence. Sharp humours in the ſtomach or bowels, from indigeſtion, often produce ſpaſms and convulſions; which are only to be cured, by correcting or expelling the offending matter. In ſome conſtitutions, a plethora will produce convulſive motions, which are cured by bleeding. If the plethora ariſes from a ſuppreſſion of the menſes, then you ſhould bleed in the foot, and endeavour to bring a return of the menſes.

Nervous fits, or at leaſt the ſymptoms attending them, widely differ in different conſtitutions: but when we have diſcovered the nature of the ſymptoms, we ſhall endeavour to aſſign the cauſes that ſupport theſe ſymptoms; for theſe two principles, are as inſeparable as cauſe and effect. There can be no diſeaſe without a cauſe, nor a cauſe without its ſymptoms or effects; for the

the ſame cauſe muſt neceſſarily produce the ſame effects.

Some, upon the firſt invaſion of the hyſteric paroxyſm, faint away, and fall into a ſyncope or ſwooning; they involuntarily graſp their hands together; fix their teeth; ſtretch out the body; and lie ſtill. We ſhall therefore call this the STILL *hyſteric fit*.

By and by they give ſigns of recovery, and are almoſt choaked with wind; which diſcharges itſelf plentifully in rifts and belchings; then they weep, laugh, ſigh, ſob and cry by turns; till preſently they fall away again in a faint: then head, hands and legs are ſtrongly convulſed; tho' the trunk of the body has often little motion. Theſe fits perhaps return five or ſix times without intermiſſion, out of one into another, till at length they gradually revive, and return to their ſenſes, by fetching a deep groan; which is a ſure indication of the fits going off.

Theſe fits commonly proceed from ſome very great paſſion, as grief, diſappointment

in

in love, &c; they are the moſt dangerous of any in their conſequences, and very difficult of cure. They indicate a defect of the circulation of the blood, in ſome principal organ; and the fits are unable to remove the cauſe, at leaſt but partially.

In ſome conſtitutions the paroxyſm comes on with a fixed, intolerable pain; which is ſometimes drawn to a point, with an excruciating torture; as if a ſharp inſtrument was puſhed into the ſkull; it often darts from the head into the ſtomach, back, or bowels, and there occaſions what is called the hyſteric cholic; which is attended with frequent reachings and vomitings of green poracious bile: by and by it ſhoots into the muſcles, and produces an hyſteric rheumatiſm; and after afflicting the patient for days, weeks or months, it often terminates in the jaundice; upon which the patient finds himſelf better. This we ſhall call the PAINFUL *hyſteric fit.*

All the larger veſſels, under nervous diſorders, greatly ſuffer; but the liver is the greateſt

greateſt ſufferer; and detaches a vaſt quantity of bile into the inteſtines; but if the periſtaltic motion of the inteſtines is inverted; the bile, finding the paſſage into the ſtomach freeſt and moſt open, ruſhes into it, and excites ſevere bilious vomitings. If the bilious ducts are ſtopt in the courſe of the diſeaſe; then the hyſteric paroxyſm ends in the jaundice. When the ſolids are relaxed, and the ſecretions obſtructed, then the perſpirable matter, being thrown on the heart, is, by the force of its contractions, thrown upon the head, and obſtructs the brain, and produces that thumping pulſe already mentioned; but if the matter is thrown upon the fineſt nerves, that immediately derive their origin from the brain, and are moſt ſuſceptible of an impulſe, they are conſequently obſtructed, whereupon a larger quantity of the animal æther circulates through the unobſtructed nerves; and their motion coming too briſkly upon the ſenſorium, makes the impulſe too ſtrong, and raiſes a perception of pain in the ſoul, great or leſs, according to the degree of impulſe; whence thoſe violent

pains,

pains, that come to a point, as if a knife or awl was thruſt into the ſkull.

In other conſtitutions, the fit makes its invaſion with ſtrong convulſions over all the body; the patient either falls or is thrown upon the ground, with great violence, as in an epilepſy; looſes ſometimes the uſe of all the ſenſes; and the exerciſe of all the ſoul's faculties, is at once interrupted; reaſon, reflection and memory are diſconcerted: the eyes are either immoveably fixed, or roll about in a very frightful manner; the head ſoon begins to be variouſly agitated with ſundry kinds of motions, the lips tremble, the noſe is contracted and drawn inwards, the teeth chatter or claſh againſt one another: ſome continually cough or bark; in others, the windpipe, thorax and organs of reſpiration are convulſed by the aſcending ſpaſms, and the patient is in danger of being ſuffocated, which evidently appears from the blackneſs of the face, at that time; ſoon after the ſtomach and bowels begin to heave and work to and fro, in an unnatural manner; the hands cling together; the

legs

legs and arms are affected with diverſe bindings, and irregular motions, and this we ſhall call the ASCENDING *convulſive hyſteric fit*.

Sometimes we find the ſpaſms, in place of aſcending and affecting the reſpiratory organs, deſcend and ſwell the abdomen to an incredible degree, while the organs of reſpiration, to appearance, ſubſide a little; when the fit is at the height, the nervous ſyſtem is greatly convulſed, and the patient acquires preternatural ſtrength; diverſe parts of the body, eſpecially the trunk, heave and work very much; and the ſpaſms ſo convulſe the inner coats of the inteſtines, as to raiſe uncommon murmurings, ſometimes like the noiſe of cats and dogs; ſometimes they nearly imitate the human voice. This we ſhall call the DESCENDING *convulſive hyſteric fit*.

In this fit, the exerciſe of the faculties of the ſoul, are diſordered or entirely interrupted; the eyes roll about, or remain fixed and drawn in, and the whites turned up;

the head, feet, hands and legs, are convulſed with various bendings and contractions; ſometimes the body is ſtretched out; foam works from the mouth; and if the fit is very ſevere, there is blood or bloody ſtreaks mixed with the foam: ſometimes the patient lies hours in the fit: after recovery he finds his limbs ſtiff and numbed; his bones ſore; his head dizzy; and perhaps is ſeveral hours before he recovers ſight; he remembers nothing that happened during the fit.

When theſe ſymptoms continue long they lay hold of the reaſon, and interrupt the ſoul in the exerciſe of its faculties: when they have got that length, they produce new ſymptoms, which we ſhall afterwards conſider.

THE CURE OF CONVULSIONS, SPASMS, NERVOUS AND HYSTERIC FITS.

As the immediate cauſe, of all theſe complaints, ariſes from ſomething, that irritates the nerves, and affects them with diſagree-

able

able ſenſations; therefore the cure muſt be attempted, by all medicines, that ſtupify and leſſen the ſenſibility of the nerves, as opium, muſk, &c. which muſt be given in large doſes; alſo all remedies that relax and render the nerves leſs ſenſible of irritation, as bleeding, fomentations, hot bath, pediluvium, and diaphoretics, as camphor and hartſhorn, which not only relax, but force off the offending matter by perſpiration. In convulſive motions or ſpaſms, theſe remedies are often uſeful, which by exciting pain or diſagreeable feeling in a ſound part of the body, in a great meaſure leſſen or deſtroy the ſenſe of that irritation, which produced thoſe ſymptoms, as bliſters, acrid cataplaſms, cupping, friction, cold bath, aſafætida, caſtor, muſk, all volatile ſalts and ſpirits, brimſtone, &c. The cramps or ſpaſms in the legs are cured by opium, fomentations, brimſtone, bandages, pediluvium, &c. tying the garter tight above the knee, and, when the cramp comes, puſhing it upwards, till it is very tight, often cures the cramp: getting out of bed, or putting the foot or hand into cold water, will often do the ſame.

In violent and laſting cramps of the ſtomach, ſome blood ought to be taken away, whether they ariſe from a ſuppreſſion of the menſes, or from any other cauſe; then opiates and cooling agglutinating medicines ought to be given; if they ariſe from the gout or other acrid matter, then we may give an emetic; which is to be worked off with ſtrong decoctions of camomæle flowers and brandy; and if the patient is weakly, the pain is to be mitigated with opium and ſtrong cordials; and in both caſes we are, as ſoon as poſſible, to ſtrengthen the ſtomach by the bark, agreeable cordials and aromatics, bitters, chalybeates, exerciſe, &c.

Vomits, elixir proprietatis, pil. gummos. tinctura ſacra, &c. are of wonderful ſervice in all nervous and hyſteric fits.

During the fit, which is deſigned to throw off the load of oppreſſive matter, we can do little but preſerve the body from being injured in the ſtruggles; but as ſoon as the leaſt

leaſt remiſſion offers, give the following draught.

℞ Aq. fontan. ℔ßſs ſyr. violar. ʒi laudan. liquid. ſpt. vitriol. āā gut. 25 m. ut. f. hauſt.

vel

℞ Camphor. gr. 15 gum. arab. ℈i ſyr. e. mecon. ʒiſs aq. alexeter. ſimpl. ʒ2 m. ut. f. hauſt.

vel

℞ Camphor. gr. 10 extract. thebaic. gr. iſs. ſyr. e. cort. aurant. q. s. ut. f. bolus.

vel

℞ Theriac. androm. ℈2 ſal. c. c. gr. 7 camphor. gr. 3 m. ut. f. bolus.

If the diſeaſe ariſes from obſtructions of the womb, which indicate that the fibres of the matrix are too weak to forward the menſtrual diſcharges; and if a plethora appears in the veſſels, twitching pains, ſwimming, giddineſs, &c. in the head, the ſure attendants on obſtructions, take away ʒ8, 10, or 12, of blood from the foot; which will take off the fulneſs in the veſſels, and give

give the remaining blood a free motion; by which means, it will make a ſtronger impulſe upon the obſtructed veſſels of the womb.

After bleeding, if the patient is ſubject to reachings, we may give a vomit to diſlodge the phlegmatic humours of the ſtomach, which are the cauſe of indigeſtion: the vomit ſhould be mild in its operation, and ſhould be often repeated at proper intervals, as the occaſion requires. If there are contraindications for vomiting, we muſt endeavour to diſlodge thoſe ſluggiſh humours, in hot and dry habits, by cooling purges of ſalts, &c. In phlegmatic conſtitutions, by more ſtimulating medicines, as tinct. ſacra, elix. proprietatis, pil. gummos. &c. as,

℞ Tinct. ſacr. ℥2 ſyr. e. ſpin. cervin. ℥4 ſpt. vol. ol. gut. 20 m. f. hauſt.

Then we ought to aſſiſt the circulation of the fluids with bark, chalybeates, &c.

℞ Conſerv. f. cort. aurant. hiſpal. N. M. cand. āā ℥6 ſpec. aromatic. ℥1ſs. chalyb. ſimpliciter p. ℥4 ſyr. e. cort.

e. cort. aurant. q. s. ut f. elect. cap. q. n. m. ter in die, ſuperbil. cochl. 4 ſequen.

℞ Aq. pulegij. ſimp.—caſtor. āā ʒ4 ſyr. e. mecon. ʒſs. ſp. laven. dul. ʒ1 ſacchar. alb. ʒ ſs. m.

Then we muſt endeavour to relieve the head, by applying a bliſter to it, or by a perpetual bliſter, iſſue, or ſolon in the neck, with the conſtant uſe of the pediluvium, and the following medicines: as,

℞ Galb. as. fœtid. āā ʒ1 rad. zedoar. ϑ2 ſal. vol. ſuccin. ʒſs. bals. peruvian. ϑ1 extract. martis. q. s. ut. f. pil. cap. 4 vel 5 mane & hora ſom. cum cochl. 4 ſequent.

℞ Aq. cinnamom ſimpl.—n. m. āā ʒ2ſs. ſyr. e. cort. aurant. ʒ1 m.

But here I muſt obſerve that volatile ſalts and ſpirits are too ſtimulating in convulſive diſeaſes, if the patient is hot and bilious; tho' they agree extremely well in heavy, cold, phlegmatic habits, where the blood moves ſlow, and the corpuſcles are very viſcid.

In thoſe fits attended with great pain, which we called the PAINFUL *fit*, immediate

aſſiſtance

assistance must be procured by opiates; and in that most inexpressible torture, called the *hysteric cholic*, the following will give immediate relief, viz.

Mitte sanguinem e brachio ad ℥ 12; deinde quamprimum cape

℞ Panac. antimon. gr. 4 opij. gr. 2 extract. hellebor. neg. gr. 5 bals. peruvian. q. s. ut. f. pil. superbib. seq. haust.

℞ Aq. pulegij. ℥2 tinct. croci. ʒ2 syr. balsam. ℥2 m.

If the pain is lodged in the crown of the head, bathe the temples with

℞ Sp. lavendul. c. ℥1ss sp. sal. ammon. ℥ss sp. vin. camphor. ℥ss m.

If that does not give ease, add a little opium to the foregoing, and bathe the part affected with it; apply leeches to the temples; bathe the feet, use cupping and scarification, and blister the part.

The *still fits*, which are brought on by some violent passions, give a shock to the whole nervous system, are very difficultly cured:

As

As nothing can be done under the fit, but by opiates with fœtid gums, volatile ſalts, aromatics and alkaline ſpirits in proper juleps; yet, when the violence of the convulſions ceaſes, give emetics, and repeat them before the return of every paroxyſm; during the intervals give the medicines already directed for accompliſhing the firſt and ſecond intentions in the cure of nervous diſeaſes; and if theſe medicines are duely continued, they cannot fail of ſucceſs, if the diſeaſe is not beyond the reach of any medicines. The greateſt ſtreſs is to be laid upon vomits often repeated, bitters with the bark, chalybeate waters, &c. Thoſe who are of thin habits, and whoſe bowels are not much ſtuffed up and obſtructed, may be recovered with gentler evacuations, ſmaller doſes of opiates, volatiles and cordials, chalybeate and mineral waters, with aromatics, bark, diet, air and exerciſe

As to childrens convulſions, if they proceed from the teething, whereby the gums and their membranes are diſtended, torn, or lacerated, they are eaſily cured, by inciſion, or by wetting the gum with a little of the

thebaic tincture: but if they ariſe from ſharp humours, in the ſtomach or bowels, they may be cured by gentle emetics of vinum antimoniale, a bliſter between the ſhoulders, and gentle rhubarb purges frequently repeated, with the teſtacious powders, magneſia alba, cinnabar, &c. taken twice or thrice a day; but eſpecially by antimonial emetics, in doſes from gut. 5 to 10 of *vin. antimon.* for a child of three days old, afterwards increaſing the doſe according to the age; immediate eaſe may be procured by a few drops of tinctura thebaica, upon ſugar, or in ſyr. of violets, or by the ſyr. e meconio; ſometimes a few drops of ſpt. of hartſhorn, taken two or three times a day, in common water, will do the buſineſs, if the conſtitution, juices and ſolids are pretty ſound.

If the fits be ſtrong, and the child further advanced in life, they muſt be encountered by gentle vomits often repeated, fitted to the age and ſtrength, with cinnabar of antimony, emetic tartar, camphor, valerian, and the rhubarb purges interchangeably uſed. During the whole time the child is upon the breaſt,

breaſt, it ſhould have nothing but the nurſe's milk and pap; and when weaned, nothing but pap, till the teething is over; if the child is much weakened in teething, then you may give a few grains of the bark, for ſome little time after teething. This method will not only cure the fits, but rickets alſo, which proceed from acrid humours in the ſtomach, bowels, or in ſome other part of the body, and from a relaxation of the ſolids. Nothing more effectually prevents or cures the rickets, than the cold bath: and in childrens' febrile heats, obſtruction of urine, coſtiveneſs, &c. nothing is better than the hot bath; carefully wrapping them up afterwards in flannels. The cold bath is of ſo great ſervice to children, that every child ſhould be bathed as ſoon as it comes into the world; and continued every day for a dozen years after: no mother needs be afraid of hurting her child by the conſtant uſe of the cold bath; though the child be never ſo weakly. When the child is extremely weak, ſea bathing is beſt, if it can conveniently be had.

CHAP. V.

OF AN EPILEPSY.

THE epilepſy is a dangerous, terrible and diſheartning diſeaſe; ſeldom any, or at leaſt very few eſcape without a ſtroke of the palſy; which generally ends their lives. Young children well treated, and even older people, may be recovered and get well; by giving ſtronger doſes, and a longer courſe of the medicines directed for convulſive fits. The ſymptoms of this diſeaſe are a ſudden dropping down, as if ſhot, tearing themſelves, clinching the hands, biting the tongue, grinding the teeth, foaming at the mouth, with a ſmall trembling, unequal and ſometimes intermitting pulſe, and an involuntary ſecretion of all the natural diſcharges, having ſcarce any knowledge of what they do, or what is done to them; but the moſt dangerous of all is, their violent convulſions and involuntary motions, by which they tear, bruiſe and deſtroy themſelves, if not with-held.

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The fit generally terminates in a dozing or lethargy; which continues longer or ſhorter, according to the violence of the paroxyſm; then by degrees their ſpirits and ſtrength return, though with much lowneſs, confuſion and ſtupidity.

From this account it is evident, that an epilepſy differs very little, if at all, from nervous and hyſteric fits, and may properly enough be called a higher degree of them; for when nervous fits continue long, they have all the ſymptoms of epilepſies; and when epilepſies begin to yield to medicines, they dwindle into hyſterics. Therefore the method of cure will differ in nothing but in the doſes: the diet indeed muſt be cooler, lighter, and perhaps entirely vegitable; vomits ſhould be oftener repeated than in the ſlighter kinds of fits. The following forms are very good.

℞ Myrrh. gr.10. rad. valerian. ℈1 caſtor. croci āā gr.5 ſal. ſuccin. gr.4 m. f. pulv.

vel

℞ Sal. martis. myrrh. gr.8 croci caſtor āā gr.5 ol. ſabin. gut.2 ſacchar. alb. ℈ſs. m. f. pulv.

vel

vel

℞ Pulv. hellebor. nig. gr. 15 ſal. ſuccin. gr. 6 caſtor. croci ā gr. 5

vel

℞ Spec. aromatic. croci āā gr. 6 ſal. ſuccin. myrrh. camphor. āā gr. 5 m.

vel

℞ Pulv. cort. peruvian. ʒ1 pulv. hellebor. nig. ʒ3 pulv. valerian. ſyl. ʒ2 ſal. tartar. ʒ3 conſerv. abſinth. rom. q. s. ut f. elect.

vel

℞ Pulv. cort. peruvian ʒ3 mithridat. ʒ2 camphor. ℈2 æthiop. mineral. ʒ2 ſyr. caryophyl. q. s. ut f. elect.

vel

℞ Pulv. cinnabar. nativ. ʒ3 caſtor. ſal. ſuccin. āā ʒ1 ol. majoran eſs. gut. 12 balſ. peruv. q. s. ut f. pil. mediocres D. 2 vel 3 ter in die.

CHAP.

CHAP VI.

OF THE PALSY, AND ST. VITUS'S DANCE.

THOSE nervous diſorders which are attended with loſs of voluntary motion, or ſhaking in any particular organ or limb, or over all the body, are called paralitic.

All the diſeaſes, from an univerſal palſy, a hemiplegia, or palſy of a particular limb, to a deafneſs, numbneſs, weakneſs or coldneſs, upon any of the external or internal parts, owe their origin to a weakneſs and relaxation of the nerves, and interruption of the circulation of the animal æther.

When any of the muſcles are deprived of the nervous influence, they are not only rendered paralitic, but ſoon after become ſmaller; becauſe the circulation of the fluids, cannot be carried on as uſual, through the

the very ſmall veſſels, when they are deprived of the nervous power: the growth of the muſcles, and every other part of the body, is occaſioned by the growth of the ſmalleſt fibrillæ; therefore when the circulation is ſtopt in the ſmalleſt veſſels, then the body muſt grow ſmaller.

Thoſe palſies, which happen to good, ſound conſtitutions, and firm nerves, from cold, moiſt and damp ſituations, exceſſive labour, a blow, fall, &c. generally yield to bleeding, antimonial emetics, the bark, ſteel bitters, cordials. *Bliſters*, warm cauſtic applications, as fomentations, baths, active and penetrating ointments and epithems, warm oils, fleſh bruſh, wraping well up with flannels, and Bath water internally and externally.

If the perſon is in the decline of life, with viciated juices, and weak nerves, and has laboured under nervous diſorders; then the palſy is either univerſal over all the body; one ſide is affected; or one part of the body, as the upper or under part;

or

or laſtly, one particular limb or muſcle is diſeaſed. There is generally reaſon to conclude from the appearances, that beſides the laxity of the nerves, there are alſo obſtructions in the capillary veſſels, from ſome fault in the animal juicies, the removing of which cures the palſy.

If a perſon, about the meridian of life, is ſeized with a paralytic diſorder, which is not cured, at leaſt prevented from ſettling and confirming at firſt; the perſon is ſeldom or ever after totally free from it, whatever methods are tried: therefore as ſoon as the diſeaſe is diſcovered, we ſhonld bleed bleed, if the patient is ſtrong, the pulſe full, a giddineſs in the head, &c. and apply a bliſter to the head, then to the neck, legs, arms, but eſpecially to the parts affected; and give active warm purges of hellebore, tinct. ſacr., &c. and we ought never to neglect antimonial emetics.

In the intervals between the evacuations, we ſhould brace up the ſolids with chalybeates, the bark, bitters, aromatics; and rub the affected part with the fleſh bruſh, then

with warm ſtimulating oils and ointments, as opodeldoch, camphorated ſpirit of wine: the cold bath is alſo of uſe, where the conſtitution is ſound.

Palſies ſometimes follow an apoplectic, epileptic or ſtrong nervous paroxyſm; they are not always curable; but, in a conſtitution tolerably good, if the general method of cure in nervous diſeaſes, has been regularly purſued, ſeldom any thing worſe happens from it, than the loſs of the uſe of the part or parts affected; and the patient may live as long under it as under an amputation.

St. VITUS's DANCE is a mixture of palſy and convulſion; it very often ariſes out of an epilepſy, eſpecially in young perſons, when the original diſtemper is overcome, and a greater degree of ſtrength obtained; though ſometimes 'tis only a prelude to that ſevere diſtemper, and may itſelf ſometimes be an original diſeaſe: it may be cured by repeated antimonial emetics, and a due uſe of the medicines already preſcribed; the cold bath, or cold water thrown upon the body, is of great ſervice.

CHAP.

CHAP. VII.

OF AN APOPLEXY.

AN apoplexy is the moſt frightful and fatal diſtemper of all the tribe of nervous diſeaſes; few outlive the firſt, fewer the ſecond, and none the third; thoſe who are ſeized with a deep ſtroke of it, have ſcarce any warning, but a ſudden and violent head-ach, a ſickneſs at the ſtomach, or a cholic; and perhaps they have no ſign at all, but drop down immediately without ſenſe or motion; the nerves of ſenſe and voluntary motion, entirely loſe their power of feeling, and the organs or parts to which they are diſtributed, become quite inſenſible: they ſcarce retain any ſign of life, except now and then an uncertain twitching or beating of the pulſe; the breathing is hardly diſcoverable, even on the ſurface of a glaſs; there is a conſtant ſnoring in the throat and noſtrils.

There are three kinds of apoplexies; 1ſt, a ſymptomatic. 2dly, an accidental. 3dly, an acquired.

The *firſt* ariſes from a tranſlation of gouty, rheumatic matter, eriſipelas, &c. to the brain.

The *ſecond* comes from a wound, bruiſe, &c. of the head.

The *third* proceeds from an apoplectic diſpoſition, acquired by groſs feeding, great drinking, voluptuouſneſs, lazineſs, &c.

The immediate cauſe of an apoplexy proceeds either from a rupture of the blood veſſels in the brain, whereby a great quantity of blood is extravaſated upon its membranes, or into its cavities, which preſſes upon the origin of the nerves, ſo as to interrupt their operations and functions; from whence the forementioned appearances may be eaſily deduced, and this may be occaſioned by a fall, bruiſe, or any other accident upon the ſkull, or by too much blood; or by the blood's being too much heated

heated by violent exercise, immoderate sensal pleasures, &c. which seems to be the cause of the apoplexies of hot counries. The other kind of apoplexies, which happen in colder countries, is occasioned by an extravasation of serum, &c. upon the membranes and cavity of the skull; and seems to be the only curable apoplexy: but two or more paroxysms burst the vessels, and bring on an incurable one.

Hence we can easily form the indications of cure, but little is to be expected, if it is not taken in the begining, and while it is weak, and the patient strong, young, and and otherwise sound.

We must begin with the most plentiful bleeding, that can be ventured upon, from the temporal artery and veins of the foot, blisters are to be immediately applied to the head and feet, the shoulders and neck cupped and scarified; and sharp cooling, and acrid glysters injected; the assistance of all fœtid, and stimulating medicines must be made use of; and warm cordial medicines

are

are to be thruſt down in a liquid form. In apoplexies of the ſanguinous and inflammatory kind, we muſt uſe all means to cool the blood, and allay its boiling heat by acids, acidulated draughts, mild balſamics, gentle cathartics, cool diet, &c.

The other apoplexy muſt be treated in the ſame way, only the medicines may be a little ſtronger and warmer; continual drains by bliſters, iſſues, ſeatons, &c. are to be ſet a going. After the patient is a little recovered, he ſhould enter upon the general methods of cure, already laid down, for nervous diſeaſes.

SECT.

SECT. IV.

CHAP. I.

OF HYPOCHONDRIACAL MELANCHOLY.

IN the laſt or higheſt ſtages of nervous diſeaſes, we have nothing but frightful ſymptoms preſenting themſelves to our view. We find nothing now but horror. The patient's ideas are dark, gloomy, confuſed and unſteady: he is harraſſed with diſquietude, anxiety and deſpair.

The former ſymptoms only oppreſſed the bodily organs; now they more immediately oppreſs the organs, on which the ſoul diſplays its faculties.

The other organs are not unaffected, but the ſoul is leſs attentive to their ſufferings. Dr. Cheyne obſerves, that this diſeaſe is ſeldom in a high degree, where the liver is

not

not faulty, either tumified, obſtructed, or ſcirrhous: for the liver is the ſink of the body; it is deſigned to ſuck out all the poiſonous and hurtful qualities, in our food; that it may become innocent and uſeful to the body. It purifies the whole maſs of blood; and throws the hurtful and excrementitious parts into the guts. Accordingly we ſee, that, upon the uſe of proper medicines, when we open the obſtructions of the gall bladder, and liver; then green, yellow, or black choler, is plentifully poured into the guts and ſtomach. When the obſtructions are not too ſtrongly formed; then nature ſometimes accompliſhes this work, without the help of medicines: if the bile is emptied into the ſtomach, it occaſions thoſe reachings and vomiting, that often affect nervous people.

The bile, of all the fluids in the body, putrifies ſooneſt: but never acquires that high degree of putrifaction, which the other fluids, arrive at; otherwiſe many more would die of nervous diſeaſes.

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The bile, in its natural ſtate, is of great uſe in the body; by its acrimony it ſtimulates the inteſtines and forwards the periſtaltic motion; by its bitterneſs and ſaponacious nature, it reduces the chyle to an uniform fluid, and ſcours and cleanſes the mouths of the abſorbent veſſels from all mucus, &c. The irregular diſcharge of the bile, and laxity of the inteſtines, occaſion the irregularity of the ſtools, in nervous diſeaſes; and the obſtruction of the bile is the occaſion of the yellowneſs, obſerved in the jaundice.

In hypochondriacal melancholy, we behold the patient under the greateſt affliction, which deſerves our moſt cordial pity. In the night, he is diſturbed with many fearful, terrible, abſurd and phantaſtic viſions, that prevent his ſleep. He is generally of a pale, lean, ſwarthy, and gloomy complection, occaſioned by his fears, anxieties, &c. yet, in his lucid intervals, has often an excellent apprehenſion, fine wit, and good memory. The pulſe varies, ſometimes it is quick, at other times ſlow, but

ways unequal. The ſtools are generally black, hard, and ſmall in quantity. The urine moſtly pale, crude and watery, varying in its colour, according to the conſtitution of the patient and the degree of the diſeaſe.

Some fancy themſelves turned into glaſs, hens eggs, tea-cups, &c. &c. and act as if the metamorphoſis was really made. Some think they are dead, and muſt be laid out; others that they are damned; ſome again fancy that they are elected, and therefore cannot ſin; while others think they have ſwallowed and have in their bellies, toads, cats, ſerpents, hares, coblers, &c.

As for the religious elects or methodiſt ſaints, if any female amongſt them fancies that ſhe has got a cobler in her belly, I ſhould neither deny the enthuſiaſtic viſion, nor the reality of the fact; for I ſincerely believe there are many methodiſts, more for the ſake of thoſe viſions, new births, and holy overſhadowings, than from a deſire of ſerving and worſhiping God acceptably. Many of them, I am ſure, have a greater inclination

to get, than to be begotten; to generate than to be regenerated.

If the habit is phlegmatic, then they are full of fears and ſcruples about the ſincerity of their repentance; if they are hot and bilious, they fancy they are the elect, the only ſaints, and may do what they pleaſe; what God Almighty hath declared ſin in others, he will not reckon ſo in them; and theſe notions, from the preaching of their carnal hot-headed, deſigning teachers, are fixed and improved upon them.

The ſtomach ſuffers greatly under this diſeaſe; the patient frequently brings up acid, ſharp and hot matter, either by vomiting, rifts, or windy belchings; the breath is often ſhort, with ſudden ſtops; he is oppreſſed with a fear of ſuffocation, and feels a pain as if a cord was tied tight round the breaſt. He is often very ſullen, ſuſpicious and touchy; ſeldom allows the ſoul to reſt from turning over diſmal and frightful reflections; and if there happens any ſudden, ſurprizing or unexpected turn in his affairs; if he meets with any great diſappointment, he immediately falls into me-

melancholy madneſs; which may not improperly be called another ſtage of the ſame diſeaſe; for 'tis nothing but the foregoing ſymptoms improved upon the conſtitution.

THE CURE OF HYPOCHONDRIACAL MELANCHOLY.

WHEN the diſeaſe has advanced ſo far as to affect the exerciſe of the ſoul's faculties, we muſt then make uſe of more powerful remedies; for the coheſions and obſtruction are ſtrongly wedged upon the conſtitution. We muſt make frequent uſe of ſtrong antimonial emetics, and apply the cicuta plaſter to the hypochonders. If there is a plethora, take away ſome blood from the temples or foot. If the viſcera are ſound, uſe the cold bath; let cold water fall, from the height of 20 or 30 feet, upon the head; and make uſe of the medicines already mentioned. If the diſeaſe is within the reach of cure, it will yeild to the regular uſe of theſe medicines, in ſufficient doſes, and continued for a due time.

CHAP.

CHAP. II.

OF MELANCHOLY MADNESS.

I Now advance from a gloomy ſcene to a ſtill gloomier; nothing but continual, uninterrupted horror reigns here. The patient is now loſt to himſelf, friends, relations, and acquaintance.

He is dark and benighted, at noon day, and is afraid to behold the face of the ſun.

The body now ſcarce feels the ſevereſt uſage, that can be inflicted upon it; becauſe the nerves of the ſeveral organs, that convey ſenſation, are ſo relaxed and obſtructed, that they can hardly afford the ſoul any perception from the impreſſions of objects. He endures thirſt, hunger, watching, to an almoſt incredible degree; becauſe the organs, which convey theſe ſenſations, are ſo relaxed, as ſcarce to be able to raiſe an idea of theſe deſires in the ſoul.

If the perſon was religious, then he deſpairs of God's mercies; he howls and cries, as if he was really burning in hell.

If atheiſtically inclined, then he raves, and blaſphemes God and religion, in his outrageous phrenzy; and, if not carefully watched, will put an end to his wretched life.

If the patient continues any time, under theſe melancholy ſymptoms; and if the conſtitution is ſanguine, hot, and bilious; then new ſymptoms are produced, which, when they appear, we diſtinguiſh by the name of *mania*, *lunacy*, or *raging madneſs*; which we ſhall, under the next head, conſider.

The blood, being thick, groſs, and heavy, circulates very languidly; becauſe the nervous fibres of the heart and arteries are relaxed, and impel the blood too faintly; conſequently it forms into a thick, heavy maſs. The ſecretions are very deficient; and the animal æther is ſmall in quantity,

and

and languid in its motions; which occaſions fear, ſadneſs, and deſpair. Seeing the fibres are very much relaxed, the larger organs will be unable to perform their office; conſequently, digeſtion is ſlow; few diſcharges by ſtool and urine; the cravings of hunger, thirſt, and ſleep, ſeldom; the ſeminal veſſels are ſhrivelled up, conſequently no perception of luſt.

If the perſon has been religious; as his ſoul, when the body was in health, often reflected upon religious duty; then it turns upon that topic: and, in place of deſpairing of his recovery, which he did before, when he was only hypiſh, he now deſpairs of forgiveneſs, everlaſting happineſs, &c.

THE CURE OF MELANCHOLY MADNESS.

In order to cure melancholy madneſs, we muſt endeavour, by all remedies, to give a ſtimulus to the ſolids; to reſtore their contractile force; and to open the viſcid obſtructions. Vomiting is of ſingu-

lar

lar ſervice, not only to diſcharge the ſtomach of its viſcid contents, but alſo to ſhake the glewy and tenacious matter, that obſtructs the brain, and hinders a due ſecretion of the animal æther. The vomits ſhould be of the rougheſt kind, otherwiſe they will have no effect. Purging medicines of black hellebore are much extolled; but the white will be found more certain and efficacious. As bliſters both ſtimulate the ſolids, raiſe the ſpirits, and open obſtructions, we muſt, upon no account, omit them. Setons and iſſues, in the neck, anſwer good purpoſes; and camphor is of wonderful ſervice; for it is penetrating, and dries up the ſuperfluous moiſture of the brain, and reſtores it to its due tone.

There is no danger in giving it in large doſes, as ℈1, 31, or 2; as

℞ Aſ. fœtid. 33 ſal. vol. ammon. camphor. āā 31ſs. rad. gentian. 31 balſ. peruvian. gut. 20. extract. martis. q. s. ut f. elect. cap. q. n. m. mane, hora ante prandium, hora 4ta & ante ſom. ſuperbib. coch. ſeq.

℞ Hel-

℞ Hellebor. nig. ℥ 1ſs flor. chamœmel. m. 1. rad. gent. ℥ 1. ſem. cardamom ℥ 2 coq. in aq. fort. q. s. ad ℥ 10, cola; cui adde tinct. chalyb. aq. caſtor. āā ℥ 3. ſp. lavend. ℥ ſs. m.

We ought always to give, along with the bark, bitters, the tincture of white hellebore, or *vin. antimon. & camphor*, *&c.* The cold bath does good, and the hot bath a great deal, if a large quantity of ſalt is thrown into the water, ſo as to make it a kind of brine, with which the whole body ought to be ſtrongly rubbed. When the patient comes out of the bath, he ſhould be wrapped up with flannels, put to bed, and there take a diaphoretic medicine. When begins to recover, if a female, a few ounces of blood ought to be frequently taken from her; otherwiſe the menſes will not eaſily return; and the melancholy madneſs will turn to a mania, or raging madneſs, from which there is no great hopes of recovery.

CHAP. III.

OF LUNACY, OR RAGING MADNESS,

LUNACY, or Raging Madneſs, is only melancholy madneſs, improved in a hot, ſanguine, bilious habit. The patient now appears with a fierce, grim, rough, wild aſpect: the exerciſe of the ſoul's faculties is bewildered and loſt; the perſon has preternatural ſtrength, ſo as to be able to break bars of iron, chains, &c. He is never tired with the *moſt ſevere* bodily exerciſe; and hardly knows what cold, faſting, ſtripes, hunger, and ſleep are. Some are remarkably ſwift of foot, bold, impudent, revengeful, and moſt violently outrageous; ready to kill themſelves or others. They ſleep very little. Their urine is little in quantity, and high coloured. The pulſe quick, low, and very unequal. The ſtools ſmall in quantity, hard, and white. Reſpiration is ſlow, and hardly perceptible. If religion takes his imagination, he fancies himſelf a Prophet, the Holy Ghoſt, &c.

Now,

Now as we have demonſtrated, that the ſoul follows the direction of the nerves and impulſes of the animal æther; and that the exerciſe of its faculties is varied, depreſſed or exalted, in proportion a the nervous æther is remitted or intended; we are enabled to aſcertain all the cauſes, that produce the various ſymptoms of lunacy.

As the nerves, in melancholy madneſs, are relaxed, ſometimes ſo greatly as hardly to be able to raiſe a perception in the ſoul at all: ſo in lunacy they are greatly too elaſtic, whereby the impulſes received from objects, are ſtruck with a very great force upon the ſenſorium; whence the ideas of the ſoul are bold, and daring. They perſpire little, and ſeldom go to ſtool; becauſe they have no craving for food: and as they have little waſte, ſo they can live long without food.

Are not theſe nervous diſeaſes, the ſame with thoſe which our Saviour and his diſciples cured. The world, at that time, believed that the patients were poſſeſſed with devils,

ſome of them indeed might be influenced by the devil, who underſtands the power of the elements, and is called the prince of the power of the air; he might bring on theſe diſeaſes, by operating upon the atmoſphere and the bodily organs. Surely theſe ſymptoms were not produced by the workings of the devil within the bodies of men: neither does it leſſen the miracle of our Saxiour's cure, either to think that they were natural diſeaſes of the nervous kind; or that they aroſe from the devil's operation upon the air, and external organs of the body.

CURE OF LUNACY OR RAGING MADNESS.

In melancholy madneſs, the ſolids are relaxed and the circulation languid; ſo in lunacy, they are ſtrong and under violent contractions. Therefore in order to accompliſh a cure, we muſt relax, ſupple and bring them to their natural ſtate. Here we can do nothing without bleeding, purging, vomiting

vomiting, &c. We muſt uſe medicines of the moſt violent operation; and we muſt uſe them boldly too, for I believe 'tis owing to the timidity of practitioners; that this diſeaſe is ſo generally deemed incurable. 'Tis a cruelty of the higheſt degree, and ſurely the moſt *bitter* tenderneſs, not to adminiſter powerful remedies; when the nature of the caſe abſolutely requires it: and yet, 'tis out of tenderneſs, our modern practitioners are ſo reſerved, in adminiſtering medicines powerful enough.

In this caſe the moſt violent vomits, the ſtrongeſt purges and liberal bleeding are to be often repeated; alſo cooling, ſoftening and relaxing medicines are conſtantly to be uſed. If the fæces are hard, and don't come away kindly, then give cooling purges, &c. As the cold bath was uſeful in melancholy madneſs; ſo the hot bath will prove equally uſeful here, to ſoften and relax. But we muſt be careful, and always upon the watch, that we do not relax the fibres too much: if this happens, the patient, juſt before raving mad, now becomes dull, ſtupid and melancholy:

melancholy: this approaching change is known by the patient's diſcovering ſome degree of reflection, and in ſome meaſure being ſenſible of his condition. He ſometimes falls into tears, and then into a moaping melancholy. In this caſe, we muſt uſe all our endeavours to prevent the change; by generous medicines, cordial bitters, the bark, cold bath, &c. This is a dangerous and fatal change, which the patient ſeldom or ever ſurvives, and, for the moſt part, dies in a few weeks.

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